University of London

607922

REPORTS

FROM

COMMISSIONERS, INSPECTORS,

AND OTHERS:

TWENTY-SEVEN VOLUMES.

—(13.)—

NATIONAL GALLERY;
NATIONAL PORTRAIT GALLERY; METEOROLOGY;
PATENTS; SCIENCE AND ART;
VETERINARY DEPARTMENT;
WEIGHTS AND MEASURES.

Session

5 *February* —— 13 *August* 1875.

VOL. XXVII.

1875.

REPORTS

FROM

COMMISSIONERS, INSPECTORS, AND OTHERS:

1875.

TWENTY-SEVEN VOLUMES:—CONTENTS OF THE

THIRTEENTH VOLUME.

N.B.—*THE* Figures *at the* beginning of the line, *correspond with the* N° *at the foot of each* Report; *and the* Figures *at the* end of the line, *refer to the* MS. Paging *of the Volumes arranged for The House of Commons.*

NATIONAL GALLERY:

✓ 5. Annual Report of the Director of the National Gallery for the Year 1874 - - - - - - - - - - p. 1

NATIONAL PORTRAIT GALLERY:

✓ 234. Eighteenth Annual Report of the Trustees of the National Portrait Gallery, 1875 - - - - - - - - - - 11

* METEOROLOGY:

✓ [c. 1307.] Report of the Meteorological Committee of the Royal Society, for the Year ending 31st December 1874 - - - - 17 } *Octavo*

PATENTS FOR INVENTIONS:

✓ 392. Report of the Commissioners of Patents for Inventions, 1874 - 101

* SCIENCE AND ART:

✓ [c. 1264.] Twenty-second Report of the Science and Art Department of the Committee of Council on Education; with Appendices - 121 } *Octavo*

VETERINARY DEPARTMENT:

✓ [c. 1321.] Annual Report of the Veterinary Department of the Privy Council Office for the Year 1874; with an Appendix - - - 667

* WEIGHTS AND MEASURES:

✓ [c. 1302.] Ninth Annual Report of the Warden of the Standards on the Proceedings and Business of the Standard Weights and Measures Department of the Board of Trade for 1874-75 - - - 787 } *Octavo.*

Vol. XXVII.—Sess. 1875.

* *For these Reports see the Volume lettered* XXVII, *Octavo portions.*

NATIONAL GALLERY.

RETURN to an Order of the Honourable The House of Commons, dated 5 February 1875;—*for*,

COPY "of ANNUAL REPORT of the DIRECTOR of the NATIONAL GALLERY to the TREASURY, for the Year 1874."

CONTENTS.

REPORT - - - - - - - - - - - - - - - - - p. 1

APPENDIX.

1. Details respecting Pictures purchased during the year 1874 - - - - - - - p. 3
2. Details respecting Bequests and Donations to the Gallery during the year - - - p. 5
3. List of Pictures which have been protected with Glass during the year - - - - p. 6
4. Number of Visitors to the National Gallery - - - - - - - - - - p. 6
5. Details relating to Copying in the Gallery - - - - - - - - - p. 7
6. Return of the Number of Catalogues sold during the year 1874 - - - - - p. 8

REPORT.

National Gallery,
25 January 1875.

My Lords,

I HAVE the honour to submit to your Lordships the following Report on the National Gallery for the year 1874.

The present Trustees are, in the order of their nomination,—

William Russell, Esq.
The Marquis of Northampton.
The Right Hon. Austen Henry Layard.
The Right Hon. William Henry Gregory.
Sir Walter C. James, Bart.
Viscount Hardinge.

The subjects of the Report are—

I. Purchases of Pictures.

II. Bequests and Donations.

III. Loans.

IV. Details relating to the Gallery and Establishment.

I.—PURCHASES OF PICTURES.

The collection of early Italian schools has been enriched by the addition of 14 pictures from the Barker collection, sold by auction in London in the month of June 1874.

These works were purchased by a special grant voted by Parliament in August last, amounting to 10,395 *l.*, viz.:—

1. "Madonna and Infant Christ," by Antonio Vivarini.
2. "Madonna in Prayer," by Cosimo Tura.
3. "The Madonna in Ecstasy," by Carlo Crivelli.
4. "St. Catherine," by Carlo Crivelli.
5. "Mary Magdalene," by Carlo Crivelli.
6. "The Nativity," by Pietro della Francesca.
7. "Madonna and Child," by Benvenuto da Siena.
8. "The Triumph of Chastity," by Luca Signorelli.
9. "The Return of Ulysses to Penelope," by Bernardino Pinturicchio.

10, 11, 12. The story of Griselda, from Boccaccio's *Decameron*, by Bernardino Pinturicchio. In three compositions, "The Marriage," "The Divorce or Separation," and "The Restoration."

13. "Mars and Venus," by Sandro Botticelli.

14. "Venus Reclining," by Sandro Botticelli.

Owing to want of space it has not been possible to yet place all these pictures in the Gallery. For full details, *see* the Appendix, No. 1.

II.—BEQUESTS

II.—BEQUESTS and DONATIONS.

Bequests.

Three pictures by the late Thomas Sword Good, of Berwick-on-Tweed, have been bequeathed by his widow, Mrs. Mary Evans Good:

1. "No News."

2. "A Fisherman with a Gun."

3. "A Study of a Boy."

4. A picture of "Orpheus charming Birds and Beasts with the Music of his Lyre," by Roelandt Savery, has been bequeathed by S. James Ainslie, Esq.

Donation.

1. A "Portrait of Cardinal Fleury," by Hyacinthe Rigaud, has been presented by Mrs. Charles Fox. (For details, *see* Appendix, No. 2.)

III.—LOANS.

1. The *Colonna Raphael* still remains deposited in the Gallery, but is not exhibited, and the Trustees are absolved from all responsibility while the picture remains under their care. (Treasury Letter, dated 26th July 1873.)

2. The special loan selections of *Turner Sketches* are at present, one set in the National Gallery of Ireland, at Dublin; another set, with the Bristol Fine Arts Academy; the third set is now in London, having been returned by the National Gallery of Scotland, where the exhibition has proved so satisfactory that the Board of Manufactures has expressed its desire for the loan of the third selection prepared, when available.

IV.—DETAILS relating to the GALLERY and ESTABLISHMENT.

Pictures cleaned or repaired and varnished.

The following works having become much disfigured by blisters, or obscured by cracks, have been carefully repaired, and re-varnished:—

1. "Portrait of a Lady, as St. Agatha," No. 24, Carr-Bequest, by Sebastiano del Piombo. Blistered; now protected with glass.

2. "The Holy Family," No. 17, Carr-Bequest, by Andrea del Sarto. Blistered; now protected with glass.

3. "Diana and her Nymphs Bathing," No. 320, Vernon collection, by Thomas Stothard, R.A. Cracked; now protected with glass.

4. "The Philosopher," No. 384, Vernon collection, by Henry Wyatt. Cracked.

5. "Wood Nymph," No. 339, Vernon collection, by Thomas Phillips, R.A. Cracked.

6. "The Old Pier at Littlehampton," No. 345, Vernon collection, by Sir A. W. Calcott, R.A. Cracked; has been lined.

7. "The Hop Garland," No. 421, Vernon collection, by W. F. Witherington, R.A. Cracked.

8. "View of the Maas, near Rotterdam," No. 146, Ollney-Bequest, by Abraham Stork. Has been cleaned and lined. Returned to the South Kensington Museum, on loan.

Pictures protected with Glass.

During the year 1874, 25 pictures have been protected with glass, 12 foreign and 13 British, making the total number of oil and tempera pictures so preserved from surface dirt and moisture, 338. (*See* Appendix, No. 3.)

Number of Visitors to the National Gallery.

The Galleries in Trafalgar-square and at South Kensington have (assuming that all the visitors to the Museum attend the Picture Galleries) been visited by 1,721,431 persons, on the public days, during the year 1874: 807,304 at Trafalgar-square, and 914,127 at South Kensington.

The daily average attendance at Trafalgar-square, open to the public 188 days, has been 4,291 for 1874; for the year 1873 it was 4,410.

(*See* Appendix, No. 4, for details.)

Copying in the Gallery.

Full particulars relating to copying in the Galleries are given in the Appendix.

The collections at Trafalgar-square and South Kensington have received during the year 17,602 visits from students; and independent of partial studies, 419 oil-colour copies of pictures have been made, 140 from the works of 48 old masters, and 279 from the works of 40 modern masters.

(*See* Appendix, No. 5.)

Catalogues.

A return of the sales of the three catalogues sold at the doors is given in the Appendix (No. 6).

The edition of the catalogue of Foreign Schools now on sale is the *sixty-sixth*, that of the British School the *twenty-ninth.*

The proceeds of the sales are paid in to Her Majesty's Exchequer as Extra Receipts. The total number sold in the year 1874 was 6,015, slightly exceeding the sale of 1873.

Details relating to the Establishment.

The vacancy in the complement of Trustees, notified in the last Report, has been filled up by the appointment of Viscount Hardinge to the trust, in the room of Mr. Thomas Baring, deceased. (Treasury Letter, No. 3235, February 1874.)

On the 20th of February last, the Lords Commissioners of Her Majesty's Treasury were pleased to appoint me by Treasury warrant to the office of Director of the National Gallery, for the usual term of five years, as successor to Sir William Boxall, R.A., resigned.

On the 9th of December, John Dixon was appointed Curator in the room of William Hillier Bailey, who died on the 29th of November previous. J. R. Ashley was promoted to the place of Dixon, and W. Oldham to that of Ashley, on the same date. (Treasury Letter, No. 18,569, 9th December 1874.)

The vacancy of an assistant porter's place caused by the promotion of Oldham has not yet been supplied.

The new galleries, the foundations of which were commenced to be excavated on Whit-Monday, the 20th of May 1872, are now far advanced towards completion. In the past autumn two doorways of communication with the present rooms in the east wing were opened and completed; they have since been boarded over, and the pictures removed on the occasion have been rehung in their old places, till the time that the new galleries shall become available for exhibition purposes.

The general account relating to the establishment is, by the direction of the Lords of the Treasury, sent in by the Accounting Officer, the Keeper and Secretary, monthly and annually, to the Exchequer and Audit Department, Somerset House.

I have, &c.
(signed) *Fred. W. Burton,*
Director, National Gallery.

The Lords Commissioners of
Her Majesty's Treasury.

APPENDIX.

Appendix, No. 1.

DETAILS respecting PICTURES purchased for the NATIONAL GALLERY at the Sale of the Barker Collection in London, in the Month of June 1874.

1. *Antonio Vivarini* (painting 1444—1451), Venetian School.—"Madonna and Infant Christ," under an ornamental arch, festooned with fruit; angels in front presenting fruit. The infant is an entire figure, standing. Painted in *tempera* on wood, 1 foot 10 inches high, by 16½ inches wide; under glass; numbered 904. Not yet placed in the Gallery. Price 189 *l.*

2. *Cosimo Tura* (about 1418—1481), Ferrarese School.—"The Virgin Mary," seated in prayer, an open book on her knees. Painted in *tempera* on wood, 17½ inches high, by 13 inches wide; under glass; numbered 905. Not yet placed in the Gallery. Price 84 *l.*

3. *Carlo Crivelli* (painting 1468—1493), Venetian School.—"The Madonna in Ecstasy." The Virgin, covered by a mantle of blue and gold, is standing in a marble

recess, looking up to the Almighty, and the dove seen above; two angels bear a scroll, and support a crown over her head; in the scroll is written—

"Ut in mente Dei ab initio concepta fui, ita et facta sum."

A rich piece of drapery is hung behind the Virgin, and on her right hand is placed a painted majolica jug, containing carnations and red and white roses; on the other side is a glass vase holding a lily.

Signed and dated—

"KAROLI CHRIVELLI VENETI MILITIS PINSIT, 1492."

Formerly in the chapel of the Malatesta family, in the church of San Francesco, at Rimini. Painted in *tempera* on wood, 6 feet 3 inches high, by 3 feet wide; numbered 906. Not yet placed in the Gallery. Price 577 *l.* 10 *s.*

4. *Carlo Crivelli.*—"St. Catherine and St. Mary Magdalene," two small entire figures, with their attributes, standing in niches; Catherine with a wheel, and Mary with a small vase. Painted in *tempera* on wood, each panel 14½ inches high, by 7¼ inches wide; numbered together 907; under glass. Placed in the Gallery in August. Price, the pair, 210 *l.*

5. *Pietro della Francesca* (about 1415—1494), Umbrian School.—"The Nativity of Our Lord." The child is lying on the ground on the corner of the mantle of the Virgin, who is kneeling in adoration; five angels singing are accompanying themselves on musical instruments. In the background is a ruined shed or stall, in which are seen an ox and an ass. Joseph is seated behind the Virgin on the ass's saddle; near him are two shepherds; in the distance, a hilly landscape and the view of a town. Unfinished.

Formerly in the possession of the Marini-Franceschi family, of Borgo San Sepolero, descendants of the painter, from whose hands it passed into those of the Cavaliere Frescobaldi, a connection of that family in Florence, who sold it in 1861 to Mr. Alexander Barker. Painted in oil on wood, 4 feet 1 inch high, by 4 feet wide; numbered 908. Placed on an easel in the Gallery in the month of June. Price 2,415 *l.*[*]

6. *Benvenuto da Siena*, or Benvenuto di Giovanni del Guasta (1436—1507), Sienese School.—The Madonna and Child, Enthroned;" the Virgin placing a sprig of white roses in the hand of the infant; two angels on the throne behind playing on musical instruments; forming the centre of an altar-piece. Painted in *tempera* on wood, 5 feet 6½ inches high, by 2 feet 2½ inches wide; numbered 909. Not yet placed in the Gallery. Price 525.[†]

7. *Luca Signorelli* (1441—1524), Tuscan School.—"The Triumph of Chastity." In the foreground, Cupid on his knees is bound by maidens, his darts taken possession of, and his bow broken; three male figures are looking on apparently unconcerned. In the distance are two other groups of maidens, in one of which the god of love is being captured, and in the other he is led away in triumph with his arms pinioned behind him. Signed, Lucas Coritius—Luke of Cortona. In a companion fresco to this, painted about 1509, in the same palace at Siena, the painter has used the complete Greek form in his signature, ΛΟΥΚΑΣ Ο ΚΟΡΙΤΙΟΣ ΕΠΟΙΕΙ.

This fresco, originally painted in the Pandolfo Petrucci Palace, was transferred from the wall to canvas in 1844, by Pellegrino Succi, for M. Joly de Bammeville, from whose collection in 1854 it passed to Mr. Barker. Measure, 4 feet ½ inch high, by 4 feet 4 inches wide; numbered 910; protected with glass. Hung in the Gallery in June. Price 840 *l.*[‡]

8. *Bernardino Pinturicchio*, Bernardino di Betto, commonly called *Pentorichio*, the little painter (1454—1513), Umbrian School.—"The Return of Ulysses to Penelope." The princess is seated at her loom; on the floor at her right is a damsel winding thread on shuttles from a ball of yarn, with which a cat is playing. Four suitors in gay costume have entered the room, and in the background Ulysses himself is seen in the doorway, just entering; his bow and quiver of arrows are hanging up above the head of Penelope.

From the open window is seen the ship of Ulysses', with the hero bound to the mast; syrens are sporting themselves in the sea; the palace of Circe is on an island near, with swine and other animals in its vicinity.

Painted about 1509, in fresco, in the Pandolfo Petrucci Palace at Siena; transferred to canvas for M. Joly de Bammeville in 1844; subsequently in Mr. Barker's collection. Measure, 4 feet 1 inch high, by 4 feet 9½ inches wide; numbered 911; protected with glass. Hung in the Gallery in June. Price 2,152 *l.* 10 *s.*[§]

9, 10, 11. *By the same.*—The story of Griselda, from Boccaccio's *Decameron*,[‖] in three compositions:—the Marriage; the Divorce, or Separation; the Restoration.

I. *The Marriage.*—The Marquis of Saluzzo, a sovereign prince, while out hunting, meets with Griselda, a peasant girl, and falls in love with her. He has her attired in fine clothes, and marries her.

The marriage is being celebrated in the centre of the picture. On the spectator's right is seen the humble home of Griselda's father, where she used to work and tend his sheep.

---

[*] Vasari, *Vite*, &c. Ed. Le Monnier, vol. iv., p. 13, note.

[†] Milanesi, *Documenti, &c., dell' Arte Senese*, vol iii., p. 79.

[‡] Della Valle, *Storia del Duomo d'Orvieto*, Rome, 1791. Vasari, *Vite*, &c. Ed. Le Monnier, vol vi., 1850.

[§] Vasari, Ed. Le Monnier, vol. vi., p. 153.

[‖] Giorn X. 10. *Il Marchese di Saluzzo.* *See* also Chaucer's Clerk's Tale, *Canterbury Tales.*

II. *The Separation.*—In the course of a few years her two children, a girl and a boy, are successively taken away from her, and since supposed to have died miserably. Then, about 13 years after her marriage, she is ostensibly divorced by the marquis (the ceremony of giving back the wedding ring is represented in the centre of the picture); is stripped of her fine clothing, and sent back to her father's house just as poor as she was when she was taken from it, with the exception of her smock, which she was permitted to depart in.

III. *The Restoration.*—A grand banquet is now prepared for the marquis's second wedding, as he has given out. Griselda is called back to the castle to do menial work and set the house in order, so that the new wife may be suitably received. But, instead of to a new bride, the patient woman is presented to her own long supposed dead daughter and her younger brother, who have been all this while tended in a distant city with the utmost care.

Griselda is then affectionately embraced by her husband, publicly reinstated in her proper position, and presented to all the court as an unparalleled example of conjugal obedience and patience.

Painted in *tempera* on wood, each picture 2 feet high, by 5 feet 1 inch wide; numbered 912, 913, 914; protected with glass. Owing to want of space not yet hung in the Gallery. Price of the three pictures respectively, 210 *l.*, 241 *l.*, 273 *l.*

12. *Sandro Botticelli,* Alessandro Filipepi, commonly called Botticelli (1447—1510), Tuscan School.—"Mars and Venus." The goddess, robed in white and gold, with a jewel on her neck, is reclining, on the spectator's left, with her right arm supported on a crimson cushion. Mars on the other side, undressed, is lying asleep near her; and four young satyrs are playing with his arms and armour, one attempting to rouse him by blowing a shell.

Painted in *tempera* on wood, 2 feet 3¼ inches high, by 5 feet 8½ inches wide; numbered 915. Hung in the Gallery in June. Price 1,050 *l.*

13. *By the same.*—"Venus Reclining, with Cupids." She is dressed in white, and rests with her right elbow on a cushion; three cupids or amorini at her side are sporting with fruit and roses; in the background is a hilly landscape.

Painted in *tempera* on wood, 3 feet ½ inch high, by 5 feet 8 inches wide; numbered 916. Hung in the Gallery in June. Price 1,627 *l.* 10 *s.*

Appendix, No. 2.

DETAILS respecting BEQUESTS and DONATIONS to the Gallery during the Year 1874.

Bequests.

Three pictures, by *Thomas Sword Good* (1789—1872), British School. Bequeathed by the painter's widow, Mrs. Mary Evans Good; received in the month of November, and hung temporarily at South Kensington:—

1. "No News." An old man, in a clerical suit of black, seated in a chair, with his head thrown back and his right arm resting on a table, has fallen asleep over his newspaper, still held before him on his knees. Painted in oil on wood, 21 inches high, by 17 inches wide; numbered 917; protected with glass.

2. "Fisherman with a Gun." A coast scene, north of Berwick; a rocky shore and stormy weather, with a boat drawn up on the sands, and a fisherman with a gun watching for sea-gulls. Signed, T. S. Good, 1832.

Painted in oil on wood, 15 inches high, by 17 inches wide; numbered 918; protected with glass.

3. "Study of a Boy." A boy looking out of the picture, seated at a table, with his right hand on an open book, carelessly lounging on a wooden chair; he is surrounded by books and other objects, some on the floor.

Painted in oil on wood, 11¼ inches high, by 9½ inches wide; numbered 919; protected with glass.

4. *Roelandt Savery* (1576—1639), Dutch School.—"Orpheus," the argonautic hero, charming birds and beasts with his lyre (violin). A rocky woody landscape, with a river, and a great variety of birds in the air; other birds and animals disposed in all directions over the scene. Orpheus is seated, playing his fiddle, on the spectator's left. Signed, Roelandt Savery, and dated, but the date is not now legible.

Painted in oil on oak, 1 foot 8 inches high, by 2 feet 7 inches wide. Bequeathed by S. James Ainslie, esq.; received in the month of December; numbered 920. Not yet placed in the Gallery.

Donation.

1. *Hyacinthe Rigaud* (1659—1743), French School.—"A Portrait of Cardinal Fleury." André Hercule de Fleury, Prime Minister of Louis XV.; he died in 1743, aged 89.

Painted in oil on canvas, 2 feet 8½ inches high, by 2 feet 1½ inches wide.

Presented by Mrs. Charles Fox. Received in the month of June 1874, and hung in the Gallery in the month of October following; numbered 903.

Appendix, No. 3.

LIST of PICTURES which have been Protected with GLASS during the Year 1874.

DATE.	PAINTER.	SUBJECT OF PICTURE.	Number in Catalogue.
1874:			
January	Roberts	Burgos Cathedral	400
,,	Jones	The Battle of the Borodino	391
,,	Sir C. L. Eastlake	Christ Lamenting over Jerusalem	397
,,	Maclise	Malvolio and the Countess	423
,,	Stothard	Diana and her Nymphs	320
February	Sir J. Reynolds	Portraits of two Gentlemen	754
,,	Hogarth	His own Portrait	112
May	Antony Moro	Portrait of Jeanne d'Archel	184
June	Ant. Vivarini	Madonna and Child	904
,,	Cosimo Tura	Madonna in Prayer	905
,,	Carlo Crivelli	St. Catherine and Mary Magdalene	907
,,	Pietro della Francesca	The Nativity	908
,,	Luca Signorelli	The Triumph of Chastity	910
,,	Pinturicchio	Return of Ulysses to Penelope	911
,,	Ditto	Story of Griselda:	
		The Marriage	912
		The Separation	913
		The Restoration	914
October	T. S. Good	No News	917
,,	Ditto	Fisherman with a Gun	918
,,	Ditto	Study of a Boy	919
,,	Andrea del Sarto	Holy Family	17
,,	Seb. del Piombo	St. Agatha	24
,,	Roberts	St. Paul's, Antwerp	401
,,	Sir M. A. Shee	Lewis the Comedian	677
,,	Witherington	The Hop Garland	421

Total Number for the Year - - - - - - 25.

At the close of the year 1874, the total number of exhibited works of Foreign Schools, protected with glass, was 202, including three cartoons and one tracing; of the British School, 136 pictures, and 202 frames of drawings and sketches. Total, 540.

Appendix, No. 4.

NUMBER of VISITORS to the NATIONAL GALLERY during the Year 1874.

Month.	Trafalgar Square.*	South Kensington.†
January	71,331	65,380
February	57,177	52,500
March	73,334	63,329
April	82,808	106,831
May	83,301	97,937
June	81,947	90,368
July	86,891	70,470
August	91,809	98,256
September	65,184	80,917
October	Closed	75,622
November	60,782	50,619
December	52,704	61,898
TOTAL	807,304	914,127

TOTAL for the Year - - - - 1,721,431

Daily average at Trafalgar Square - - - 4,291

---

* Open to the public four days in the week, except during the month of October, when the Gallery is closed for cleaning, &c.

† Open to the public six days in the week and three evenings. The returns are those of the whole Museum, there being no means of ascertaining the exact numbers visiting the National Gallery rooms.

Appendix, No. 5.

DETAILS relating to COPYING in the GALLERY.

Number of attendances on Students' days during the year 1874 - - 17,602
Trafalgar Square - - - - - - 9,950 (in 92 days).
South Kensington - - - - - - 7,652 (in 143 days).
New Students entered in the books - - - - - 376

Daily average attendance:
Trafalgar Square, in oil colours - - - - - - 71 } 107.
Ditto - in water colours - - - - - 36 }
South Kensington, in oil colours - - - - - 32 } 53.
Ditto - in water colours - - - - - 21 }

RETURN of PICTURES Copied in Oil during the Year.

Foreign Schools.			*British School.*		
Number of Copies.	Number of Pictures Copied.	Number of Masters.	Number of Copies.	Number of Pictures Copied.	Number of Masters.
140	75	48	279	85	40

PICTURES most frequently Copied during the Year.

Foreign or Old Masters.

PAINTER.	SUBJECT OF PICTURE.	Number in Gallery.	Times Copied.
Rubens	Portrait known as the "Châpeau de Paille"	852	6
Cuyp	Ruined Castle	824	6
A. del Sarto	His own Portrait	690	5
Greuze	Head of a Girl	206	5
Rembrandt	Portrait of an Old Lady	775	4
Ditto	Portrait of Himself	672	4
Hobbema	Forest Scene	833	4
Sassoferrato	Madonna in Prayer	200	4
Raphael	Madonna and Infant Christ, &c.	744	3
Correggio	Holy Family	23	3
Ditto	"Ecce Homo"	15	3
Guido	Youthful Christ and St. John	191	3
Murillo	Spanish Boy	74	3
Velazquez	Philip IV.	745	3
Rembrandt	Jewish Rabbi	190	3
Wonwerman	Landscape	882	3
W. Vandevolde	A Gale at Sea	150	3
Vandyck	Portrait of a Gentleman	52	3

Modern Masters.

PAINTER.	SUBJECT OF PICTURE.	Number in Gallery.	Times Copied.
Sir E. Landseer	King Charles's Spaniels	409	20
Ditto	The Hunted Stag	412	12
Ditto	Dignity and Impudence	604	12
Ditto	Shoeing	606	12
Ditto	Sleeping Bloodhound	603	11
Sir J. Reynolds	Heads of Angels	182	11
Sir E. Landseer	Alexander and Diogenes	608	10
Ditto	High-life and Low-life	410	9
Ditto	Highland Dogs	607	9
Ditto	Highland Music	411	8
Sir J. Reynolds	The Age of Innocence	307	8
Hoppner	Portrait of Lady Oxford	900	6
Leslie	Uncle Toby and the Widow (T. S.)	403	6
Newton	Yorick and the Grisette	353	6
Sir J. Reynolds	Infant Samuel	162	5
Gainsborough	Portrait of Mrs. Siddons	683	5
Collins	Happy as a King	351	5
Leslie	Uncle Toby and the Widow (S. K.)	613	4
Etty	The Bather	614	4
Uwins	Châpeau de Brigand	388	4
Clays	Dutch Shipping	814	4
Ditto	Dutch Boats	815	4
Dyckmans	The Blind Beggar	600	4

Appendix, No. 6.

RETURN of Number of CATALOGUES SOLD during the Year 1874.

Foreign Schools.

		£.	s.	d.
Catalogues at 1*s.*	1,712	85	12	–
„ at 3*d.*	2,131	26	12	9

British School.

		£.	s.	d.
Catalogues at 1*s.*	2,172	108	12	–
TOTAL	6,015	£.220	16	9

NATIONAL GALLERY.

Copy of ANNUAL REPORT of the Director of the National Gallery to the Treasury, for the Year 1874.

(*Mr. William Henry Smith.*)

Ordered, by The House of Commons, *to be Printed,*
5 February 1875.

5. *Under* 1 *oz.*

11

EIGHTEENTH ANNUAL REPORT

OF THE

TRUSTEES OF THE NATIONAL PORTRAIT GALLERY.

1875.

To the Lords of Her Majesty's Treasury.

The Trustees of the National Portrait Gallery have the honour to submit herewith their Eighteenth Annual Report.

Two vacancies in the list of Trustees as given in last year's Report, have since been filled by a Treasury Minute, dated 4th May 1874, by virtue of which the Marquess of Bath and the Lord Ronald Leveson Gower have been added to the Board.

The Board is now composed as follows:—

The Earl Stanhope (Chairman).
William Smith, Esq. (Deputy Chairman).
The Lord President of the Council (for the time being).
The Marquess of Bath.
The Earl of Derby.
The Earl Somers.
The Lord Ronald Leveson Gower.
The Viscount Hardinge.
The Right Honourable William Ewart Gladstone, M.P.
The Right Honourable Benjamin Disraeli, M.P.
Sir William Stirling Maxwell, Bart., M.P.
Sir Coutts Lindsay, Bart.
The Very Rev. the Dean of Westminster.
Sir Francis Grant, P.R.A.
Alexander B. Beresford Hope, Esq., M.P.

Since the date of the last Report (24th April 1874), to the present time, this meeting inclusive, the number of meetings held by the Trustees is five; and from the 9th of February 1857, when the Trustees commenced their duties, 130.

During the past year, six donations have been received; and the list of 115 already given, may now be continued as follows:

116. Sir Walter Scott, Bart., 1771—1832. A sketch in oil, on a small mahogany panel, by Sir Edwin Landseer, R.A. Exhibited at the Royal Academy in 1874, No. 457 of the Catalogue. Purchased at the sale of the Artist's works, No. 312, for 800 guineas, and presented, 22nd May 1874, by Albert Grant, Esq., M.P. The poet is represented with writing materials on a table before him. He looks away to the left, and the light is admitted from the spectator's right hand. A sword and part of a suit of armour lie upon the table, and the lower part of

of a figure in armour appears in the background, in a recess to the left. Sir Walter wears a green coat, buff waistcoat, and a black neckerchief. His black-headed walking-cane is seen within his left arm.

117. Charles Knight, 1791—1873. Author, publisher, and critic. He may be considered as one of the first in this country to render general knowledge accessible to all classes. A marble bust, sculptured by Joseph Durham, A.R.A., and the duplicate of one in Mrs. Knight's possession. Presented May 1874, by his grandchildren, the sons and daughters of George and Mary Clowes.

118. Samuel Rogers, the poet, 1762—1855. A drawing, by Sir Thomas Lawrence, in chalks on grey paper; the hands not seen. Formerly the property of his sister, Miss Rogers. It was contributed to the Portrait Exhibition of 1868, at Kensington, No. 312 of the Catalogue. Presented February 1875, by Henry Rogers, Esq., of Hagley Lodge, Worcestershire, nephew of the poet.

119. Margaret Douglas, Countess of Lennox, 1515—1578. Niece of Henry the Eighth, mother-in-law of Mary Queen of Scots, and grandmother of James the First. Painted in oil on panel, smaller than life. Painter unknown. Contributed to the Portrait Exhibition at South Kensington in 1866, No. 87 of the Catalogue. Presented February 1875, by Dr. Hugh Diamond, F.S.A., in fulfilment of the wishes of Theresa, his late wife.

120. Anne Clifford, Countess of Pembroke and Montgomery, at the age of 81, 1589—1676. Painted in oil on canvas, and similar to a portrait formerly at Strawberry Hill, engraved by Mazel for Pennant's Tour in Scotland, part 2, page 358. Painter unknown. This picture was sold in the collection of General C. R. Fox, at Christie's, 4th July 1874, No. 27 of the Catalogue, and merely designated, "Dutch School, Portrait of a Woman." A shield in the background, to the right of her head, surmounted by a coronet, bears the arms of Herbert impaling Clifford. Presented February 1875, by George Scharf, Esq., F.S.A., Keeper and Secretary to the Board of Trustees.

121. Agnes Strickland, 1797—1874. Historian of the Queens of England and Scotland. Painted by J. Hayes, 1846, and engraved by F. C. Lewis, 1851, as a frontispiece to the "Queens of England." Presented March 1875, in accordance with her will, by her sister, Mrs. Gwillym.

The purchases made were stated by the Trustees in their former Report to amount to 270. They are now increased, as the following list will show, to 280.

271. The Right Hon. Edmund Burke, 1729—1797. Painted in the school of Sir J. Reynolds. The statesman is represented nearly in profile to the left, wearing his natural brown hair, with the black string of his eye-glass passing over the cravat. This picture was formerly the property of Mr. Charles Phillips, and resembles one presented to Earl Fitzwilliam, and preserved at Milton House. Purchased 24th April 1874. Price 63 *l.*

272. The Right Hon. Warren Hastings, 1733—1818. Painted, at the age of 79, by Sir Thomas Lawrence, for the wife of Colonel Barton, Aide-de-Camp to Warren Hastings. Exhibited at the Royal Academy in 1811, No. 194 of the Catalogue. Seated facing the spectator, half length; hands joined. Inscribed with his name and age, 79. Purchased 24th April. Price 126 *l.*

273. Lord Chancellor Loughborough, afterwards Earl of Rosslyn, 1733—1805. Painted by William Owen, R.A. Half-length seated figure, wearing his official robes and long wig; resting his right hand on the purse containing the great seal. Purchased 22nd May. Price 100 *l.*

274. Lord Nelson, 1758—1805. Painted by L. F. Abbott. To the waist, the size of life; in naval uniform, decorated with the Star of the Bath and a gold medal. Head uncovered, and looking away to the left. A similar picture, belonging to Huson Morris, Esq., was engraved by Robert Graves, A.R.A., in 1847. Purchased 22nd May. Price 100 *l.*

275. Lord Chancellor Thurlow, 1732—1806. Unfinished study of a head, with powerful shadows, on twilled canvas. Similar to a picture in the corridor of Windsor Castle. Probably painted by Richard Evans in the studio of Sir T. Lawrence. Purchased 26th June. Price 15 *l.* 15 *s.* From the collections of Mr. Gibbons, and Mr. Angerstein of Blackheath.

276. Edward the Black Prince, 1330—1376. A half-length figure, in full armour. Cast in plaster by Brucciani, from the gilt metal effigy on his monument in Canterbury Cathedral. Purchased 8th February 1875. Price 15 *l.* 15 *s.*

277. King Henry the Fourth, 1366—1413. A half-length figure, in regal costume. A cast in plaster, by Brucciani, from the alabaster effigy on his monument in Canterbury Cathedral. Purchased 8th February. Price 7*l.* 17*s.* 6*d.*

278. Queen Joan of Navarre, Second Wife of Henry the Fourth, married 1403, died 1437. A cast in plaster, by Brucciani, from the alabaster effigy on the tomb of her husband in Canterbury Cathedral. Purchased 8th February. Price 7*l.* 17*s.* 6*d.*

The above-named plaster casts have been entrusted to Messrs. Elkington, of Birmingham, for the purpose of having them converted into bronze, by means of the electrotyping process.

279. John Zoffany, R.A., 1733—1810. Face nearly in profile to the left, long hair, holding a portcrayon in his right hand. Painted by himself, signed and dated 1761. Purchased 8th February. Price 50*l.*

280. Miss Mary Russell Mitford, 1786—1855. Authoress of "Our Village." A bust picture, small size, in oil colours. Painted by John Lucas. Purchased, from the studio of the artist after his decease, 11th March. Price 10*l.* 10*s.*

A complete set of the bronze medals issued by the Art Union of London, exhibiting the profile portraits of 21 artists of the British School, was presented, February 1875, by the Council of that Body.

Further donations of autograph letters from eminent persons have been received; namely, a letter from Charles Knight, presented by his grandson William C. Knight Clowes, Esq., M.A., and various letters from the Right Hon. William Pitt (December 1803), Wilberforce (1813), Spencer Perceval (November 1806), and J. Croker (July 1829), presented by General Lord Rokeby, G.C.B.

The following portraits have been protected by glass, and many of the labels that were worn have been re-written and glazed (12th June 1874):—

Lord Nelson, by Füger.
Burns.
Lord Byron.
Warren Hastings, by Lawrence.
Captain Cook.
Sir William Temple.
Sir Nicholas Bacon.
Sir W. Scott, by Landseer.
Sir J. Mackintosh.
Nollekens, by Abbott.
Lord Camden.
Keats, by Severn.
Isaac Watts.
Sir William Herschel.

The number of visitors to the Gallery on Easter Monday last, 29th March, was 4,139, against 3,800 of 1874, and 3,079 of the previous year.

On Whit-Monday of last year, May 25th, the number of visitors amounted to 1,554, against 1,371 of the year before.

On Boxing Day, 26th December 1874, the principal of the Christmas holidays, when the Gallery was only open from 10 to 4 o'clock, the number of visitors amounted to 1,128, against 2,565 of the previous year, and 2,182 of the year before.

The numbers of visitors during the first four months of the present year, are as follow:

January - - - - -	3,219
February - - - - -	2,514
March - - - - -	8,851
April - - - - -	5,141

The number of visitors to the Gallery from the commencement, in Great George-

George-street, Westminster, to the end of the year 1874, taken year by year, is shown by the following Table:

Year.	Visitors.	Year.	Visitors.
1859 - - - - - -	5,305	1867 - - - - -	24,649
1860 - - - - - -	6,392	1868 - - - - -	25,344
1861 - - - - - -	10,907	1869 (not open at Christmas)	24,757
1862 (Exhibition year) - -	17,927	1870 (opened in March, at South Kensington).	58,913
1863 - - - - - -	10,475	1871 - - - - -	63,195
1864 - - - - - -	14,885	1872 - - - - -	67,039
1865 - - - - - -	16,642	1873 - - - - -	60,047
1866 - - - - - -	24,666	1874 - - - - -	65,201

Grand Total - - - - 496,344 Visitors.

The following Table shows the Number of Visitors in each Month during the last Seven Years.

MONTHS.	1868.	1869.	1870.	1871.	1872.	1873.	1874.
January - - -	964	1,849	–	3,805	4,882	4,102	4,705
February - - -	1,384	1,347	–	4,158	5,142	2,269	3,131
March - - -	1,732	3,021	1,440	4,699	5,599	4,772	4,090
April - - - -	4,808	1,806	11,475	12,523	14,716	9,553	10,832
May - - - -	2,074	3,971	5,786	10,220	5,787	3,475	8,206
June - - - -	3,678	2,386	7,159	4,377	3,246	5,450	5,579
July - - - -	1,801	2,224	5,116	3,973	4,342	4,078	5,045
August - - -	2,503	2,780	8,307	3,616	6,386	6,091	9,067
September - - -	2,106	2,447	6,932	2,366	4,355	5,498	5,559
October - - -	1,592	1,531	5,059	4,672	3,312	3,634	3,157
November - - -	1,015	923	2,594	2,179	2,357	3,014	1,826
December - - -	1,687	472	5,045	6,607	6,915	8,111	4,004
TOTAL - - -	25,344	24,757	58,913	63,195	67,039	60,047	65,201

As in their previous Reports, the Trustees find themselves again compelled to urge upon the consideration of the Lords Commissioners of Her Majesty's Treasury the difficulties which still impede an advantageous display of the portraits and works of art entrusted to their care, owing to want of space. The rooms which contain the collection are completely crowded, and there seems no possibility of devising any further means of exhibiting additional portraits within them.

In their Report of the year 1874 it was suggested by the Trustees that the Gallery might be extended in an easterly direction by building from that end of the room now occupied by bronzes and sculptures, over the ground which is at present merely covered by low temporary wooden buildings. The Gallery would then reach as far as the main line forming Exhibition-road. The ground in question has the advantage of being the property of the Office of Works, and quite apart from the ground held by the Commissioners of the 1851 and International Exhibitions.

This scheme would no doubt involve a considerable expense, and require the application of considerable space; but there are two other additions that might be made with little cost or difficulty, and with no derangement of the pictures.

First. There is the gallery now vacant on the ground floor, beneath the present long room occupied by the National Portrait Gallery, where some of the finest pictures were placed during the loan exhibitions of 1866, 1867, and 1868. The area of this basement corresponds with that of the floor above, and the two are connected by a commodious and well-constructed staircase, which is perfectly independent of other parts of the building. The space below might easily be adapted to the requirements of a Portrait Gallery. Screens branching from the

the spaces between the windows could be constructed as in the room above, and any massive pieces of sculpture that might be added to the collection would be placed without apprehension on the solid basis of that flooring. The very insecure construction of the wooden floor to the gallery above does not admit of ordinary marbles and pedestals being placed upon it, and the busts are of necessity placed upon high brackets against the walls, facing the light, where the more delicate features of the countenance are quite lost.

Secondly. There is the Gallery now occupied by the Naval Models belonging to the South Kensington Museum, and which might advantageously be placed elsewhere. The possession of this Gallery by the Trustees would be as advantageous as the possession of the Gallery below, and either would probably suffice for the additions which the Trustees may expect to make for many years to come.

Signed, by Order of the Board,

George Scharf,
Keeper and Secretary.

National Portrait Gallery,
Exhibition Road, South Kensington,
13 May 1875.

NATIONAL PORTRAIT GALLERY.

EIGHTEENTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

NATIONAL PORTRAIT GALLERY

TO THE

LORDS OF HER MAJESTY'S TREASURY.

(Presented to Parliament by Her Majesty's Command.)

Ordered, by The House of Commons, *to be Printed,*
1 *June* 1875.

234.

Under 1 *oz.*

Vol. 27. pp. 17 – 100

[C. 1307] Meteorology. Report of the Royal Society's
Meteorological Committee for the
year 1874.

For this Report see the Volume lettered
XXVII Octavo Portions

PATENTS FOR INVENTIONS.

/101

REPORT

OF

THE COMMISSIONERS OF PATENTS FOR INVENTIONS,

1874.

(*Presented pursuant to the Act* 15 & 16 *Vict.* c. 83.)

Ordered, by The House of Commons, *to be Printed,*
4 *August* 1875.

392.

REPORT, 1874.

The Commissioners of Patents appointed under the Patent Law Amendment Act 1852 (15 & 16 Vict. c. 83), in compliance with the terms of the third section of that Act, make the following Report of their proceedings, under and in pursuance of the same, for the year 1874, in continuance of their Report of proceedings for 1873.

The number of applications for Letters Patent recorded within the year 1874 was 4,492; the number of patents passed thereon was 3,162; the number of final specifications filed in pursuance thereof was 2,868; the number of complete specifications upon which patents were sealed was 236; the number of applications lapsed or forfeited, the applicants having neglected to proceed for their patents within the six months of protection, was 1,060; the number of patents void, the patentees having neglected to file final specifications in pursuance thereof, was 58, leaving 3,104 patents in force.

The Act 16 Vict. c. 5 enacts, that all Letters Patent for inventions to be granted under the provisions of the Patent Law Amendment Act, 1852, shall be made subject to the condition that the same shall be void at the expiration of three years and seven years respectively from the date thereof, unless there be paid, before the expiration of the said three years and seven years respectively, the Stamp Duties in the Schedule thereunto annexed, viz., 50 *l.* at the expiration of the third year, and 100 *l.* at the expiration of the seventh year. The patent is granted for 14 years.

Thirty-two thousand and ninety-one patents bear date between the 1st of October 1852 and the 31st of December 1867. Of this number 633 became void, the patentees having neglected to file specifications in pursuance thereof, leaving 31,458 upon which the third and seventh years stamp duties were payable. The additional progressive stamp duty of 50 *l.* was paid at the end of the third year on 8,991, and 22,467 became void. The additional progressive duty of 100 *l.* was paid at the end of the seventh year on 3,151 of the 8,991 remaining in force at the end of the third year, and 5,840 became void. Consequently about 72 per cent. of the 31,458 patents became void at the end of the third year, and about 90 per cent. become void at the end of the seventh year.

The following Table shows for each year since the Patent Law Amendment Act, 1852, came into operation, the number of applications, of patents sealed thereon, and of patents in force to the end of the 3rd, 7th, and 14th years from the date thereof:—

YEAR.	Applications for Patents.	Patents Sealed.	Patents Void for want of Final Specifications.	Patents in force to End of 3rd Year.	Patents continued in force to End of 7th Year by Payment of 50 *l.* Duty.	Patents continued in force to End of 14th Year by Payment of 100 *l.* Duty.
1852 - -	1,211	914	23	891	310	102
1853 - -	3,045	2,187	74	2,113	621	205
1854 - -	2,764	1,878	66	1,812	513	140
1855 - -	2,958	2,046	52	1,994	551	195
1856 - -	3,106	2,094	47	2,047	573	214
1857 - -	3,200	2,028	52	1,976	584	221
1858 - -	3,007	1,954	31	1,923	540	197
1859 - -	3,000	1,977	39	1,938	542	217
1860 - -	3,196	2,063	47	2,016	579	194
1861 - -	3,276	2,047	35	2,012	575	179
1862 - -	3,490	2,191	35	2,156	646	214
1863 - -	3,309	2,094	28	2,066	632	215
1864 - -	3,260	2,024	22	2,002	550	178
1865 - -	3,386	2,186	27	2,159	582	193
1866 - -	3,453	2,124	24	2,100	574	227
1867 - -	3,723	2,284	31	2,253	619	260
1868 - -	3,991	2,490	34	2,456	729	
1869 - -	3,786	2,407	41	2,366	793	
1870 - -	3,405	2,180	40	2,140	738	
1871 - -	3,529	2,376	38	2,338	819	
1872 - -	3,970	2,771	37	2,734		
1873 - -	4,294	2,974	68	2,906		
1874 - -	4,492	3,162	58	3,104		

All

All the provisional, complete, and final specifications filed in the office upon the patents granted under the Act since 1852 have been printed and published in continuation, with lithographic outline copies of the drawings accompanying the same, according to the provisions of the Act 16 & 17 Vict. c. 115.

The provisional specifications filed in the office and lapsed and forfeited have also been printed and published in continuation.

Printed certified copies of the specifications filed in the office, as also certified copies of patents, and of the Record Book of Assignments of Patents and Licenses, with copies of such assignments and licenses, have been sent, in continuation, to the Office of the Director of Chancery in Edinburgh, and the Enrolment Office of the Court of Chancery in Dublin, pursuant to the Act of 1852, and the Act of 16 & 17 Vict. c. 115.

The work of printing the Specifications of Patents under the old law, 13,561 in number, and dating from 1711 to 1852, was completed in 1858, and copies thereof are sold in the office at the cost of printing and paper.

Abridgments of specifications, in classes and chronologically arranged, are in course of preparation and publication. The classes already published and on sale at the office, at prices covering the cost of printing and paper, are—

1. Drains and sewers, including the manufacture of drain-tiles and pipes.
2. Sewing and embroidering. (2nd edition.)
3. Manure.
4. Preservation of food.—Parts I. and II.
5. Marine propulsion.—Parts I., II., III., and IV.
6. Manufacture of iron and steel.—Parts I., II., III., and IV.
7. Aids to locomotion.
8. Steam culture.
9. Watches, clocks, and other timekeepers.—Parts I. and II.
10. Firearms and other weapons, ammunition, and accoutrements.—Parts I. and II.
11. Paper.—Manufacture of paper, pasteboard, and papier-mâché.—Parts I. and II.
12. Paper.—Cutting, folding, and ornamenting; including envelopes, cards, paper-hangings, &c.
13. Typographic, lithographic, and plate printing.—Parts I. and II.
14. Bleaching, dyeing, and printing fabrics and yarns.—Parts I. and II.
15. Electricity and magnetism, their generation and applications.—Parts I. and II. (2nd edition.)
16. Manufacture and applications of india-rubber, gutta-percha, &c., including air, fire, and water-proofing.
17. Production and applications of gas.—Parts I. and II.
18. Metals and alloys.
19. Photography.—Parts I. and II. (2nd edition.)
20. Weaving.—Parts I. and II.
21. Shipbuilding, repairing, sheathing, launching, &c.—Parts I. and II.
22. Bricks and tiles.—Parts I. and II.
23. Plating or coating metals with metals.—Parts I. and II. (2nd edition.)
24. Pottery.—Parts I. and II.
25. Medicine, surgery, and dentistry. (2nd edition.)
26. Music and musical instruments. (2nd edition.)
27. Oils, fats, lubricants, candles, and soap. (2nd edition.)
28. Spinning; including the preparation of fibrous materials, and the doubling of yarns and threads.—Parts I. and II.
29. Lace and other looped and netted fabrics.
30. Preparation and combustion of fuel.
31. Raising, lowering, and weighing. (2nd edition.)
32. Hydraulics. (2nd edition.)
33. Railways. (2nd edition.)
34. Saddlery, harness, stable fittings, &c.
35. Roads and ways.
36. Bridges, viaducts, and aqueducts.
37. Writing instruments and materials.
38. Railway signals and communicating apparatus.
39. Furniture and upholstery.
40. Acids, alkalies, oxides, and salts.
41. Aeronautics.
42. Preparation and use of tobacco.
43. Books, portfolios, card-cases, &c.
44. Lamps, candlesticks, chandeliers, and other illuminating apparatus.
45. Needles and pins.
46. Carriages and other vehicles for railways.
47. Umbrellas, parasols, and walking sticks.
48. Sugar.

49. Steam engine.—Parts I. and II.
50. Paints, colours, and varnishes.
51. Toys, games, and exercises.
52. Ventilation.
53. Farriery, including the medical and surgical treatment of animals.
54. Artists' instruments and materials.
55. Skins, hides, and leather.
56. Preparing and cutting cork, bottling liquids, securing and opening bottles, &c.
57. Brushing and sweeping.
58. Nails, rivets, bolts, screws, nuts, and washers.
59. Hinges, hinge-joints, and door-springs.
60. Locks, latches, bolts, and similar fastenings.
61. Cooking, bread-making, and the preparation of confectionery.
62. Air, gas, and other motive power engines.
63. Water closets, earth closets, urinals, &c.
64. Safes, strong rooms, tills, and similar depositories.
65. Wearing apparel.—Division I. Head coverings.
66. Wearing apparel.—Division II. Body coverings.
[67. Wearing apparel.—Division III. Feet coverings.
68. Wearing apparel.—Division IV. Dress fastenings and jewellery. In course of preparation.]
69. Anchors.
70. Metallic pipes and tubes.
71. Mining, quarrying, tunnelling, and well-sinking.
72. Milking, churning, and cheesemaking.
73. Masts, sails, rigging, &c., including apparatus for raising and lowering ships' boats.
74. Casks and barrels.
75. Steering and manœuvring vessels.
76. Optical, mathematical, and other philosophical instruments; including nautical, astronomical, and meteorological instruments.

By a rule of the Commissioners of Patents, dated 17th December 1866, it is ordered that after the 31st December 1866 every applicant for Letters Patent shall deliver at the office of the Commissioners with his provisional specification, or (when a complete specification is filed with the petition and declaration) with his complete specification, an abridgment of such provisional or complete specification. The abridgments delivered in pursuance of this rule for the years 1867, 1868, 1869, and 1870, were printed and published in the quarterly volumes after the expiration of the six months' protection. The volumes for the years 1867 and 1868 were published under the title of "Descriptive Index." In the volume of this Index for the year 1869, all the information previously furnished in a separate form by the Chronological Index was given (as well as an alphabetical index of names); the title was changed to "Chronological and Descriptive Index of Patents applied for and Patents granted;" and the Chronological Index ceased to appear as a distinct publication.

In consequence of the receipt of a memorial signed by a large number of patentees, manufacturers, and literary and scientific men, the Commissioners of Patents decided that the abridgments delivered after the 1st January 1871, should be published weekly (instead of quarterly) with indexes of persons and subjects. The Chronological and Descriptive Index for 1871, with Indexes of Names and Subject-matter, accordingly commenced in a weekly form on the 14th July 1871. The Indexes for the years 1872, 1873, and 1874 have been printed and published in like manner. In the body of the work the abridgments of the provisional and complete specifications are published in regular numerical order at the expiration of the term of *six months* from *the date of application*. But each weekly number has an appendix, containing the abridgments open to public inspection before the expiration of the term of six months (in consequence of the patentees having filed their final specifications), and also the abridgments of complete specifications just received. These abridgments are subsequently printed in the body of the work in their proper places, in order to preserve the numerical and chronological arrangement of the book. The Indexes of Names and Subject-matter refer to the abridgments in the appendixes, as well as to those in the body of the work. In the Indexes of each successive number for the years 1871, 1872, and 1873, all the previous indexes were incorporated until the end of the year, and then with the last No. [52] the complete Alphabetical and Subject-matter Indexes for the year were published, to be bound with the 52 weekly parts in one volume. This practice has been still

still followed with the Subject-matter Index for the year 1874, but with the Index of Names only to the publication of the 31st No., when the Alphabetical Index for the whole year was published.

It is also intended to publish these abridgments in classes as soon as the abridgments of all the specifications from the earliest period to the end of 1866 have appeared in a classified form. Until that takes place the inventor (by the aid of the Subject-matter Index for each year) can continue his examination of the abridgments relating to the subject of his invention in the Chronological and Descriptive Index.

A free library and reading rooms are open to the public daily, from 10 till 4 o'clock, in the Office of the Commissioners of Patents, 25, Southampton-buildings, Chancery-lane. In addition to the printed specifications, indexes, and other publications of the Commissioners, the library includes a collection of the leading British and Foreign Scientific Journals, and text-books in the various departments of Science and Art.

Complete sets of the Commissioners of Patents' publications (each set including more than 3,330 volumes, and costing for printing and paper upwards of 3,150 *l.*) have been presented to the authorities of the most important towns in the kingdom, on condition that the works shall be rendered daily accessible to the public, for reference or for copying, free of all charge. The following list gives the names of the towns, and shows the place of deposit, so far as ascertained, of each set of the works thus presented :—

Aberdeen (Mechanics' Institution).
Belfast (Queen's College).
Beverley (Guildhall).
Birmingham (Central Free Library—Reference Department, Ratcliff-place).
Blackburn (Free Library and Museum, Town Hall-street).
Bolton-le-Moors (Public Library, Exchange Buildings).
Bradford, Yorkshire (Borough Accountant's Office, Corporation Buildings, Swain-street).
Brighton (Town Hall).
Bristol (City Library, King-street).
Burnley (Office of the Burnley Improvement Commissioners).
Bury.
Carlisle (Public Free Library, Police Office).
Cork (Royal Cork Institution, Nelson-place).
Crewe (Railway Station).
Darlington (Mechanics' Institute, Skinnergate).
Derby (Free Public Library).
Dorchester.
Drogheda.
Dublin (Royal Dublin Society, Kildare-street).
Dundalk (Free Library).
Falmouth (Public Library, Church-street).
Gateshead (Mechanics' Institute).
Gorton (Railway Station).
Glasgow (Stirling's Library, Miller-street).
Grimsby, Great (Mechanics' Institution, Victoria-street).
Halifax.
Hertford (Free Public Library, Town Hall).
Huddersfield (Improvement Commissioners' Offices, South Parade).
Hull (Mechanics' Institute, George-street).
Ipswich (Museum Library, Museum-street).
Keighley (Mechanics' Institute, North-street).
Kidderminster (Public Free Library, Public Buildings, Vicar-street).
Lancaster (Mechanics' Institute, Market-street).
Leamington Priors (Public Library, Town Hall).
Leeds (Public Library, Infirmary Buildings).
Leicester (Free Library, Wellington-street).
Limerick (Town Hall).
Liverpool (Free Public Library, William Brown-street).
London (British Museum).
„ Society of Arts, John-street, Adelphi).
Macclesfield (Useful Knowledge Society).
Maidstone (Free Library).
Manchester (Free Library, Camp field).
Montrose (Free Library).
Newcastle-upon-Tyne (Literary and Philosophical Society).
Newport, Monmouth (Commercial Room, Town Hall).
Northampton.
Norwich (Free Library, St. John's, Maddermarket).
Nottingham (Free Library).
Oldham (School of Arts and Sciences, Lyceum).
Oxford (Public Free Library, Town Hall).
Paisley (Government School of Design, Gilmour-street.)
Plymouth (Mechanics' Institute, Princess-square).
Preston, Lancashire (Dr. Shepherd's Library, the Institution, Avenham)
Reading (Literary, Scientific, and Mechanics' Institution, London-street).
Rochdale (Free Public Library, Town Hall).
Rotherham (Board of Health Offices, Howard-street).
Salford (Royal Museum and Library, Peel Park).
Sheffield (Free Public Library, Surrey-street).
Southampton (Hartley Institution).
Stirling (Burgh Library, Town House, Broad-street).
Stockport (Museum, Vernon Park).
Sunderland (Corporation Museum, Athenæum, Fawcett-street).
Wakefield (Mechanics' Institution, Barstow-square).
Warrington (The Museum and Library).
Waterford (Town Hall, the Mall).
Wexford (Mechanics' Institute, Crescent-quay).
Wigan.
Wolverhampton (Free Library).
Wolverton (Railway Station).
York (Lower Council Chamber, Guildhall).

The Commissioners of Patents have also presented complete sets of their publications to the following Public Offices, Seats of Learning, Societies, British Colonies, and Foreign States :—

Public Offices, &c.

Admiralty—Chatham Dockyard.
„ Sheerness ditto.
„ Portsmouth ditto.
„ Devonport ditto.
„ Pembroke ditto.

Public Offices, &c.—continued.

Artillery Institution, Woolwich.
Board of Trade, Whitehall.
Ordnance Office, Pall Mall.
„ Small Arms' Factory, Enfield.
War Office, Pall Mall.

Public Offices, &c.—continued.

India Office.
Royal School of Mines, &c., Jermyn-street, Piccadilly.
Dublin Castle, Dublin.
Record and Writ Office, Chancery, Dublin.
Office of Chancery, Edinburgh.
Museum of Science and Art, Edinburgh.

Seats of Learning and Societies.

Cambridge University.
Trinity College, Dublin.
Queen's College, Galway.
Incorporated Law Society, Chancery-lane, London.

British Colonies.

- Barbadoes.
- British Guiana.
- Canada—Library of Parliament, Ottowa.
  - „ Bureau of Agriculture, Toronto.
  - „ Board of Arts and Manufactures, Montreal.
- Cape of Good Hope.
- Ceylon.
- India—Bengal.
  - „ Bombay.
  - „ Madras.
  - „ North-West Provinces.
- Jamaica.
- Malta.
- Mauritius.
- New Brunswick.
- Newfoundland.
- New South Wales.
- New Zealand.
- Nova Scotia.
- Prince Edward Island.
- South Australia—Colonial Institute, Adelaide.
- Tasmania.
- Trinidad.
- Victoria—
  - Parliamentary Library, Melbourne.
  - Patent Office, Melbourne.
  - Public Library, Melbourne.

Foreign States.

Argentine Republic—Buenos Ayres.
Austria—Athenæum, Vienna.
Belgium—Ministère de l'Intérieur, Brussels.
„ Musée de l'Industrie, Brussels.
France—Bibliothèque Nationale, Paris.
„ Conservatoire des Arts et Métiers, Paris.
Germany—Alsace—Société Industrielle, Mulhouse.
„ Bavaria—Königliche Bibliothek, Munich.
„ Gotha—Ducal Friedenstein Collection.
„ Prussia—Königliche Polytechnische Schule, Aix-la-Chapelle.
„ „ Gewerbe-Akademie, Berlin.
„ „ Königliche Bibliothek, Berlin.
„ „ Königliche Polytechnische Schule, Hanover.
„ Saxony—Polytechnische Schule, Dresden.
„ Wurtemberg—Bibliothek des Musterlagers, Stuttgart.
Italy—Ufficio delle Privative, Rome.
Netherlands—Harlem.
Russia—Bibliothèque Impériale, St. Petersburg.
Spain—Madrid.
Sweden—Teknologiska Institutet, Stockholm.
United States—Patent Office, Washington.
„ Astor Library, New York.
„ State Library, Albany.
„ Franklin Institute, Philadelphia.
„ Free Public Library, Boston.
„ Library Company, Philadelphia.
„ Free Public Library, Chicago.
„ Peabody Institute, Baltimore.
„ Historical Society, Madison, Wisconsin.
„ Cornell University, Ithaca, N.Y.
„ Mercantile Library, St. Louis.
„ Mechanics' Institute, San Francisco.

Grants of complete series of abridgments of specifications have been made to the undermentioned Mechanics', Literary, and Scientific Institutions:—

Aberystwith (Library and Working Men's Reading Room).
Alnwick (Scientific and Mechanical Institution).
Alton (Mechanics' Institution).
Altrincham (Altrincham and Bowdon Literary Institution).
Ashburton (Ashburton Library, East-street).
Ashby-de-la-Zouch (Mutual Improvement Society).
Ashton-under-Lyne (Mechanics' Institution).
Aylesbury (Kingsbury Mechanics' Institute).
Bacup (Mechanics' Institution).
Ballymoney (Town Hall).
Banbridge (Literary and Mutual Improvement Society).
Banbury (Mechanics' Institution).
Barnstaple (Literary and Scientific Institution).
Bath (Athenæum).
„ (Royal Literary and Scientific Institution).
Batley (Mechanics' Institution).
Battle (Young Men's Christian Association).
Belfast (Athenæum).
„ (Northern Law Club).
„ (People's Literary Institute).
Berkhampstead, Great (Mechanics' Institute).
„ (Working Men's College).
Birkenhead (Literary and Scientific Society).
Birmingham (Bloomsbury Institution).
„ (Central Lending Library).
„ (Free Library and News Room, Gosta Green).
„ (Graham-street Institution).
„ (Law Students' Society).
Bodmin (Literary Institution).
Bolton (Mechanics' Institute).
„ (School of Art).
Bournemouth (Library and Reading Room).
Bradford, Yorkshire (Church Institute).
„ (Library and Literary Society).
„ (Mechanics' Institute).
Braintree (Braintree and Bocking Literary and Mechanics' Institution).
Brampton, near Chesterfield (Local Museum and Literary Institute).
Breage (Cornwall Institution).
Bristol (Athenæum).
„ (Institution).
„ (Law Library Society).
„ (Library, Queen's-road).
Bromsgrove (Literary and Mechanics' Institute).
Burnley (Literary Institution).
„ (Mechanics' Institution).
Burslem (Wedgwood Institute).
Bury (Athenæum).
Bury St. Edmund's (Athenæum).
„ (Mechanics' Institution).
Calne (Literary Institution).
Cardigan (Mechanics' Institute).
Carharrack (Literary Institute).
Carmarthen (Literary and Scientific Institution).
Cheddar (Literary Institution).
Cheltenham (Permanent Library).
„ (Working Men's Club).
Chertesy (Literary and Scientific Institution).
Chester (City Library and Reading Room).
Chesterfield (Mechanics' Institution).
Chichester (Literary Society and Mechanics' Institute).
Chippenham (Literary and Scientific Institution).
Christchurch (Working Man's Institute).
Clevedon (Village Hall Institution for Working Men).
Cockermouth (Mechanics' Institution).
Coggeshall (Literary and Mechanics' Institution).
Colchester (Literary Institution).
„ (Young Men's Christian Association).
Compstall (Athenæum).
Coventry (Free Library).
„ (Institute).
„ (School of Art).
Crediton (Working Men's Club).
Crewe (Mechanics' Institution).
Dartmouth (Mutual Improvement Society).
Deal (Deal and Walmer Institute).
Derby (Mechanics' Institution).
Devonport (Mechanics' Institute).
Dewsbury (Mechanics' Institution).
Diss (Reading Room and Library).
Doncaster (Free Library).
„ (Great Northern Mechanics' Institute).
„ (Young Men's Christian Association).
Dorchester (County Museum and Library).
„ (Working Men's Institute).
Dudley (Mechanics' Institution).
Dukinfield (Village Library and Reading Room).
Dumbarton (Philosophical and Literary Society).
Dumfries (Mechanics' Institution).

Dundee (Young Men's Christian Association and Literary Institution).
Durham (Mechanics' Institute).
Eagley, Bolton-le-Moors (Library and Institute).
Ealing (Mechanics' Institute).
Earlestown, Newton-le-Willows (Mutual Improvement Society).
East Greenwich (Working Men's Institute).
East Retford (Literary and Mutual Improvement Society).
Ebbw Vale (Literary and Scientific Institute).
Edinburgh (Philosophical Institution).
,, (Royal Scottish Society of Arts).
,, (Subscription Library).
,, (Watt Institution and School of Art).
,, (Working Men's Club).
Egham (Literary Institute).
Egremont (Mechanics' Institute).
,, (Workmen's Institute).
Exeter (Devon and Exeter Albert Memorial Museum, School of Science and Art and Free Library).
,, (Devon and Exeter Institution).
Farnham (Young Men's Association).
Faversham (Institute).
Fowey (Working Men's Reading Rooms).
Frome (Literary and Scientific Institution).
,, (Mechanics' Institution).
Gainsborough (Literary, Scientific, and Mechanics' Institute).
Garforth, near Leeds (Working Men's Club).
Glasgow (Athenæum).
,, (Central Working Men's Club and Institute).
,, (Institution of Engineers in Scotland).
,, (Mechanics' Institution, Bath-street).
,, (Philosophical Society).
Glastonbury (Literary Institute).
Godmanchester (Working Men's Reading Room).
Gosport (Gosport and Alverstoke Literary and Scientific Institution).
Grantham (Public Literary Institution).
Gravesend (Gravesend and Milton Library and Reading Rooms).
Guernsey (Working Men's Association).
Guildford (Working Men's Institution).
Hadleigh (Young Men's Institute).
Halesworth (Mechanics' Institute).
Halifax (Literary and Philosophical Society).
,, (Mechanics' Institute).
,, (Working Men's College).
Halstead (Literary and Mechanics' Institute).
Haslingden (Institute).
Hastings (Literary and Scientific Institute).
,, (Mechanics' Institution).
Hawarden (Literary Institution).
Hebden Bridge, near Todmorden (Mechanics' Institution).
Helston (Reading Room and Library).
Hemel Hempstead (Mechanics' Institute).
Hereford (National History, Philosophical, Antiquarian, and Literary Society).
Hertford (Literary and Scientific Institution).
Heywood (Mechanics' Institute).
Hitchin (Mechanics' Institute).
Holbeck (Mechanics' Institution).
Hollingwood (Working Men's Club).
Holt, Norfolk (Literary Society).
Holywell Green (Mechanics' Institution).
Horncastle (Mechanics' Institution).
Huddersfield (Mechanics' Institution).
Hull (Church Institute).
,, (Literary, Scientific, and Mechanics' Institute).
,, (Lyceum Library).
,, (Royal Institution, Albion-street).
,, (Young People's Institute).
Huntingdon (Literary and Scientific Institution).
Ipswich (Working Men's College).
Kendal (Christian and Literary Institute).
,, (Highgate Mechanics' Institute).
,, (Working Men's Institute).
Kidderminster (Mechanics' Institute).
Lancaster (Mechanics' Institute and School of Science).
Lee, Kent (Working Men's Institution).
Leeds (Chapeltown Branch Library).
,, (Church Institute).
,, (Holbeck Branch Library).
,, (Hunslet Branch Library).
,, (Leeds Library).
Leeds (Mechanics' Institution and Literary Society).
,, (Philosophical and Literary Society).
,, (Working Men's Institute).
,, (Young Men's Christian Association).
Leek, Staffordshire (Literary and Mechanics' Institution).
Leicester (Law Society).
,, (Young Men's Christian Association).
Leighton Buzzard (Working Men's Mutual Improvement Society).
Leith (Mechanics' Subscription Library).
Lewes (Fitzroy Memorial Library).
,, (Mechanics' Institute).
,, (School of Science and Art).
Lincoln (Mechanics' Institute).
Liverpool (Institute).
,, (Medical Institution).
,, (Polytechnic Society).
Llanelly (Chamber of Commerce and Reading Room).
Lockwood (Mechanics' Institution).
London (Albert Working Men's Club, Knightsbridge).
,, (Bank of England Library and Literary Association).
,, (Beaumont Institute, Mile End).
,, (Bedford Working Men's Institute, Spitalfields).
,, (Birkbeck Institution, Southampton Buildings, Chancery-lane).
,, (Bow and Bromley-road Institute, Bow-road).
,, (Bow Common Working Men's Club, Devon road, Bow Common).
,, (Christchurch Working Men's Club, New-street, Lark Hall-lane, Clapham).
,, (Clerkenwell Club, Lower Rosoman-street).
,, (Holloway Working Men's Club and Institute, Holloway-road).
,, (Literary and Scientific Institution, Walworth).
,, (London Association of Foremen Engineers and Draughtsmen).
,, (London Institution, Finsbury-circus).
,, (London Library, St. James').
,, (St. James' and Soho Working Men's Club, Rupert-street, Soho).
,, (St. Mary Charterhouse Working Men's Club, Golden-lane).
,, (South London Working Men's College, Blackfriars-road).
,, (Southwark Working Men's Club, Broadwall, Stamford-street).
,, (Working Men's Club, Brixton-hill).
,, (Working Men's Club, St. Mark's, Victoria Docks).
,, (Working Men's Club, Triangle, Hackney).
,, (Working Men's Club and Institute, Battersea).
,, (Working Men's Club and Institute Union, Strand).
,, (Working Men's College, Great Ormond-street).
Longwood (Mechanics' Institution).
Lowestoft (Library and Reading Room).
Lye (Institution).
Lymington (Literary Institute).
Madeley, Shropshire (Anstice Memorial Workmen's Club and Institute).
Maidstone (St. Paul's Literary Institute).
,, (Working Men's Club and Institute).
Maldon, Essex (Literary and Mechanics' Institute).
Manchester (Ancoats Branch Free Library).
,, (Athenæum).
,, (Campfield Free Lending Library).
,, (Cheetham Branch Library).
,, (Chorlton and Ardwick Branch Free Library).
,, (Hulme Branch Free Library).
,, (Law Library)
,, (Mechanics' Institution).
,, (Natural History Museum, Peter-street).
,, (Owen's College).
,, (Portico Library, Mosley-street).
,, (Rochdale Road Branch Free Library).
,, (Royal Exchange Library).
,, (Scientific and Mechanical Society).
Manningtree (Manningtree and Mistley Library and Scientific Institution).
Mansfield (Co-operative Industrial Society).

Mansfield (Mechanics', Artizans', and Apprentices' Library).
„ (Mechanics' Institute).
Marlborough (Reading and Mutual Improvement Society).
„ (Working Men's Hall).
Melksham (Mutual Improvement Society).
Melton Mowbray (Literary Institute).
Mere, near Bath (Literary Association).
Middlesborough (Iron and Steel Institute).
„ (Mechanics' Institution).
Middlewich (Literary and Scientific Institution).
Modbury (Mechanics' Institution).
Mossley (Mechanics' Institute).
Newark (Mechanics' Institute).
Newbury (Literary and Scientific Institution).
Newcastle-upon-Tyne (Mechanics' Institution).
„ (Working Men's Club).
New Mills, near Stockport (Mechanics' Institute).
Newport, Isle of Wight (Young Men's Society and Reading Room).
North Shields (Free Library).
Northampton (Mechanics' Institute).
Nottingham (Mechanics' Institution).
„ (Subscription Library, Bromley House).
Odiham (Mechanics' Institution).
Oldham (Analytic Literary Institution).
„ (Mechanics' Institution, Werneth).
Ormskirk (Public Library).
Oswestry (Institute).
Over, Cheshire (Working Men's Institute).
Oxford (North Oxford Working Men's Club).
Patricroft (Mechanics' Institution).
Pembroke Dock (Mechanics' Institute).
Pendleton (Mechanics' Institution).
Penzance (Institute).
„ (Penzance Library).
„ (Working Men's Association).
Perth (Mechanics' Library, High-street).
Peterborough (Mechanics' Institution).
Plymouth (Working Men's Institute).
Pontypool (Literary Institute).
Poole (Literary and Scientific Institution).
„ (Mechanics' Institute).
Port Glasgow (Public Library).
Portsea Island (Young Men's Christian Association).
Preston (Institution for the Diffusion of Knowledge).
Redruth (Redruth Institution).
Reigate (Mechanics' Institution).
Richmond (Working Men's College).
Rotherham (Rotherham and Masbro' Literary and Mechanics' Institute).
Royston (Institute).
Rusholme (Public Hall and Library).
Ryde, Isle of Wight (Philosophical and Scientific Society.)
„ „ Young Men's Christian Association and Literary Institute).
Saffron Walden (Literary and Scientific Institution).
St. Just (Institution).
St. Leonards (Mechanics' Institution).
„ (Working Men's Club).
Salford (Working Men's Club).
Salisbury (Literary and Scientific Institution).
Saltaire (Literary Institute).
Scarborough (Mechanics' and Literary Institute, Vernon-place).
Selby (Mechanics' Institute).
Sevenoaks (Literary and Scientific Institution).
Shaftesbury (Literary Institution).
Sheerness (Literary Institute).
Sheffield (Branch Free Library).
„ (Brightside Branch Library).
„ (Literary and Philosophical Society, School of Arts).
„ (Mechanics' Institution).
Shepton Mallett (Reading and Mutual Improvement Society).
Sidmouth (Mechanics' Hall).
Skipton, Yorkshire (Mechanics' Institute).
Slough (Mechanics Institute).
Smethwick, Staffordshire (Library, Reading Room, and Literary Institute).
Southampton (Polytechnic Institution).
„ (Workmen's Hall).
Southport (Athenæum).
South Shields (Public Free Library).
Southwell (Literary Institution).
Spalding (Mechanics' Institute).
„ (Christian Young Men's Association).
Stafford (Mechanics' Institution).
Staines (Literary and Scientific).
„ (Mechanics' Institute and Reading Room).
Stalybridge, Cheshire (Mechanics' Institution).
Stamford (Institution).
Stourbridge (Associated Institute).
„ (Church of England Association).
„ (Iron Works Reading Room and Library).
„ (Mechanics' Institution).
„ (Working Men's Institute).
Stowmarket (Literary Institution).
Stratford (Working Men's Hall).
Sudbury, Suffolk (Literary and Mechanics' Institute).
Sunderland (Working Men's Club).
Swansea (Royal Institution of South Wales).
„ (South Wales Institute of Engineers).
„ (Working Man's Institute).
Tavistock (Mechanics' Institute).
„ (Public Library).
Thornton, near Bradford (Mechanics' Institute).
Thornton Heath, Croydon (Workmen's Club).
Todmorden (Mechanics' Institution).
Truro (Cornwall County Library).
„ (Institution).
„ Royal Institution of Cornwall).
Tunbridge (Literary and Scientific Institute).
„ (Mechanics' Institute).
Tunbridge Wells (Mechanics' Institution).
„ (Society of Literature and Science).
Turton, near Bolton (Chapel Town Institute).
Tynemouth (Free Public Library).
Ulverston (Temperance Hall.)
Uttoxeter (Mechanics' Literary Institute).
Uxbridge (Uxbridge and Hillingdon Reading and Newsroom Institute).
Wakefield (Mechanics' Institute).
Wallingford (Free Library and Literary Institute).
Walsall (Free Library).
Walsham-le-Willows, Suffolk (Institute).
Ware (Institute).
Warminster (Athenæum).
Watford (Literary Institute).
Wellingborough (Working Men's Club).
Wellington (Young Men's Christian Association).
Wells, Somerset (Young Men's Society).
West Bromwich (Free Library).
Whaleybridge (Mechanics' Institute).
Whitby (Institute).
„ (Museum).
„ (Subscription Library).
Whitehaven (Mechanics' Institute).
„ (Working Men's Reading Room).
Whitstable (Institute).
Wilton (Literary Institute).
Winchester (Mechanics' Institution).
„ (Training College).
Winsford (Town Hall Reading Room).
Wirksworth (Mechanics' Institution).
Wisbeach (Mechanics' Institute).
Witham (Literary Institution).
Witney (Athenæum).
Wolverhampton (Law Library).
„ (Library).
Wolverton (Institute).
Woodbridge (Literary and Mechanics' Institute).
„ (Working Men's Hall).
Worcester (Railway Literary Institute).
„ (Workman's Hall).
Workington (Mechanics' Institute).
Yarmouth, Great (Parochial Library and Museum).
Yeovil (Mutual Improvement Society).
York (Church Institute).
„ (Institute of Popular Science, &c.).
„ (North Eastern Railway Library and Reading Room).

Presentations of portions of the Works published by order of the Commissioners of Patents, have been made to the following Libraries :—

Armagh (Town Clerk's Office).
Aylesbury (Mechanics' Institution and Literary Society, Kingsbury).
Birmingham (Institution of Mechanical Engineers, Newhall-street).
Boston, Lincolnshire (Public Offices, Market-place).
Cambridge (Free Library, Jesus-lane).
Cardiff (Free Library and Museum).
Chester (Mechanics' Institute, St. John-street).
Coalbrookdale (Literary and Scientific Institution).
Coventry (Watchmakers' Association).
Dublin (Dublin Library, D'Olier-street).
Edinburgh (Horological Society).
Ennis (Public Library).
Gloucester (Working Men's Institute, Southgate-street).
Guernsey (Public Record Office).
Guildford (Mechanics' Institute).
Ipswich (Mechanics' Institute, Tavern-street).
Kew (Library of the Royal Gardens).
Leominster (Literary Institute).
London (House of Lords).
„ (House of Commons).
„ (Honourable Society of Gray's Inn).
„ („ „ Inner Temple).
„ („ „ Lincoln's Inn).
„ („ „ Middle Temple).
„ (Aeronautical Society).
„ (Athenæum Club, Pall Mall).
„ (British Horological Institute).
„ (General Post Office).
„ (Guildhall Library).
„ (Institution of Civil Engineers).
„ (Odontological Society).
„ (Royal Society).
„ (United Service Museum).
Manchester (Literary and Philosophical Society, George-street).
„ (Mechanics' Institution, David-street).
Newcastle-upon-Tyne (North of England Institute of Mining Engineers).
Over Darwen (Free Public Library).
Oxford (Bodleian Library).
Stretford, near Manchester (Mechanics' Institute).
Swindon, New (Mechanics' Institute).
Tamworth (Library and Reading Room, George-street).
Yarmouth, Norfolk (Public Library, South Quay).

British Colonies and Foreign States.

British Columbia—Mechanics' Institute, Victoria.
„ Public Library, New Westminster.
France—Academy of Science, Paris.
Germany—Kaiserliche Universitäts und Landes-Bibliothek, Strasburg.
Netherlands—Bibliothèque de l'Ecole Polytechnique de Delft.
Russia—Imperial Technological Institute, St. Petersburgh.
Turkey—Literary and Scientific Institute, Smyrna.
United States—American Academy of Arts and Sciences, Boston.
„ American Institute, New York.
„ American Society of Civil Engineers, New York.
„ Industrial University, Champaign, Illinois.
„ Mechanics' Institution, San Francisco.
„ Mercantile Library Association, Pittsburg, Pennsylvania.
„ Odd Fellows' Library Association, San Francisco.
„ Smithsonian Institute, Washington.
„ Wabash College, Crawfordsville, Indiana.
„ Young Men's Christian Association, Scranton, Pennsylvania.

The Patent Law Amendment Act, 1852, directs that the Treasury shall provide proper places or buildings for an office or offices for the purposes of the Act. Offices so inadequate and unsuitable were provided by the Treasury as to call forth the remonstrances of the Commissioners of Patents in the form of the following Report, which was transmitted to the Treasury at so early a period as April 1858 :—

To the Lords Commissioners of Her Majesty's Treasury.

The Right Honourable *Frederic* Lord *Chelmsford*, Lord High Chancellor of Great Britain, The Right Honourable Sir *John Romilly*, Master of the Rolls, Sir *FitzRoy Kelly*, Her Majesty's Attorney-General, and Sir *Hugh M'Calmont Cairns*, Her Majesty's Solicitor General, being four of the Commissioners of Patents for Invention under the said Act, report as follows :

The 4th section of the said Act enacts, that "It shall be lawful for the Commissioners of Her Majesty's Treasury to provide and appoint from time to time proper places or buildings for an office or offices for the purposes of the said Act."

In pursuance of the requisition of the Lords Commissioners of Her Majesty's Treasury, dated in 1853, the Commissioners of Her Majesty's Board of Works provided certain offices for the Commissioners of Patents, being the ground-floor rooms of the Masters' offices in Southampton Buildings, Chancery-lane, theretofore occupied by Masters in Chancery, abolished under the Act 15 & 16 Vict. c. 80; and an annual rent of 490 *l.* is now paid out of the Fee Fund of the Patent Office to the Suitors' Fund of the Court of Chancery for the hire of the same.

This arrangement was not considered to be permanent; no lease has been granted, and as these offices are now required for the occupation of the registrars and other officers of the Court of Chancery, due notice has been given to the Commissioners of Patents, requiring them to give up possession so soon as other suitable offices can be procured.

These offices were in 1853 sufficient in number and accommodation for the ordinary business of the office.

In the year 1855 the Commissioners of Patents established a free public library within their office, containing works of science in all languages, the publications of the Commissioners, and the works upon patented and other inventions published in the British colonies and in foreign countries.

This library has greatly increased and continues to increase, partly by purchases, but in a great measure by gifts and loans of valuable and useful books. It was resorted to at the first opening by inventors, engineers, and mechanics, as well as by barristers, solicitors, and agents engaged in Patent business; it has become a collection of great interest and importance, and the number of readers has gradually so much increased that at this time convenient standing room cannot be found in the two small rooms within the office which can be appropriated to the library. It is the only library within the United Kingdom in which the public have access, not only to the Records of the Patents and Inventions of this country, but also to official and other documents relating to inventions in foreign countries, and this without payment of any fee.

A largely increased accommodation is urgently required.

No suitable building can be found in the immediate neighbourhood of Southampton Buildings, either to be rented or for purchase.

The new offices to be provided must be fireproof, for the preservation of the original specifications and other records of the office; the offices now occupied are fireproof throughout.

The Commissioners of Patents are in possession of a collection of very valuable and interesting models of patented machines and implements, as also of portraits of inventors, many of them gifts, and others lent by the owners for exhibition. They are now exhibited daily, and gratuitously, in a portion of the museum at Kensington, assigned to the Commissioners of Patents for that purpose by the Lords of the Committee of Privy Council for Trade.

A museum of this nature necessarily increases, and the number of models now exhibited may be considered as forming only the foundation of a great national museum.

The great work of printing the old specifications of patents, with the drawings attached thereto, inrolled in Chancery under the old law, dating from 1623 to 1852, and 12,977 in number, was commenced in September 1853, and fully completed in July last (1858). All have been fully indexed in series and subjects, and the indexes printed and published. These prints of specifications form about 900 volumes (450 imperial octavo volumes of drawings, and the like number of imperial octavo volumes of letter-press). The indexes form seven imperial octavo volumes.

The cost of these valuable works has necessarily been great, amounting to 92,000 *l.*

Notwithstanding this great outlay, the balance-sheet of income and expenditure for the year 1857, prepared for the annual report of the Commissioners, and laid before Parliament, shows a surplus income from the commencement of the Act, 1st October 1852, to the end of 1857, of 6,000 *l.*

The balance-sheet of income and expenditure for the year 1858, prepared, and shortly to be laid before Parliament, shows a surplus on the year of 5,900 *l.*, thereby increasing the total surplus to 11,900 *l.*

The work of printing the old specifications being completed, as above stated, the expenditure on that head ceases altogether, and consequently the surplus income of the current year (1859) is estimated at 21,600 *l.*; adding this sum to the present available surplus of 11,900 *l.*, and leaving a margin of 3,500 *l.*, 30,000 *l.* may be safely estimated as the sum available for building purposes at the end of the current year 1859.

The balance sheet of income and expenditure for the current year 1859, is estimated as follows:—

RECEIPTS.	£.	s.	d.	PAYMENTS.	£.	s.	d.
Stamp duties	86,000	-	-	Fees to the law officers	8,700	-	-
Sale of printed specifications	1,300	-	-	Fees to their clerks	800	-	-
				Salaries of officers and clerks	5,600	-	-
				Compensations	4,600	-	-
				Current and incidental expenses	7,500	-	-
				Cost of stationery supplied to the Patent Office by Her Majesty's Stationery Office	700	-	-
				Cost of purchase of books for library and binding	500	-	-
				Rent of offices	500	-	-
				Letter-press printing, lithographer's bills for drawings, and estimated cost of paper supplied to the printer and lithographer by Her Majesty's Stationery Office	17,500	-	-
				Expenses in respect of the Museum at South Kensington, and clerks' salaries for ditto	3,000	-	-
				Revenue stamp duties	16,300	-	-
				Balance or estimated surplus income of the current year 1859	21,600	-	-
£.	87,300	-	-	£.	87,300	-	-

The Act of 1853 (16 Vict. c. 5) converted all the fees imposed by the Act of 1852 into stamp duties, thereby passing the whole income of the office to the Consolidated Fund.

The expenditure of the office is estimated and voted annually by Parliament.

There is no appearance of diminution in the number of applications for patents, and they may be safely estimated to continue for future years at 3,000 in each year.

This number will produce 86,000 *l.* in stamp duties, and adding thereto 1,300 *l.* for the average annual proceeds of sales of printed specifications, the future annual gross income may be taken at 87,300 *l.* The gross income is, however, liable to a deduction of 16,300 *l.* on account of revenue stamp duties, leaving the real available future income of the Patent Office at 70,000 *l.* per annum, or thereabouts.

The Patent Law Amendment Act, 1852 (15 & 16 Vict. c. 83), imposed certain revenue stamp duties upon patents. These duties have hitherto produced 15,300 *l.* per annum, and that sum has been charged against the office in the annual balance sheet of income and expenditure.

These duties are estimated in the balance sheet above set forth for the current year 1859 to produce 16,300 *l.* or thereabouts.

The work of printing the old specifications being completed, as above stated, the yearly future cost of the current specifications, abstracts of specifications, journals, indexes, &c., in letter-press printing, lithographic printing, and paper, will not exceed 17,500 *l.* per annum, as contrasted with the average yearly expenditure on those three heads of 39,375 *l.* within the years 1856-7-8.

The Commissioners of Patents are of opinion that it it not expedient, for the present at least, to propose to Parliament a reduction of the scale of stamp duty fees imposed by the Act of 1852.

They are of opinion that the fees paid upon the passing of a patent are not too heavy; the large number of applications (3,000 in each year) accounting for the large amount of income. Any material reduction in the amount of fees would undoubtedly tend to increase the number of useless and speculative patents: in many instances taken merely for advertising purposes.

The fee stamp duties and the revenue stamp duties are as follows:—

	Fee Stamp Duties.	Revenue Stamp Duties.
	£. *s.* *d.*	£. *s.* *d.*
Within the first six months from the petition for provisional protection to the filing of the specification	20 – –	5 – –
On the patent at the expiration of the third year	40 – –	10 – –
On the patent at the expiration of the seventh year	80 – –	20 – –
(The patent is granted for fourteen years.)		

There are 3,000 petitions for provisional protection presented in each year or thereabouts. Of this number, 1,950 reach the patent, and 550 patents pay the 50 *l.* additional stamp duty required at the expiration of the third year; 1,450 patents, or nearly three-fourths of the whole, thereby becoming void. Probably not more than 100 of the surviving 550 will pay the 100 *l.* additional stamp duty required at the end of the seventh year.

Considering the beneficial results of the additional payment of 50 *l.* in sifting useless patents, the Commissioners are of opinion that it is not expedient to reduce the amount for the present at least, and so long as the surplus can be expended for the benefit of patentees and that portion of the community which is principally interested in and connected with the practical application to public purposes of discoveries and improvements in science and art.

They are of opinion that the surplus income, calculated as before stated, to amount to 30,000 *l.* at the end of the current year 1859, and to increase in each succeeding year at the rate of 20,000 *l.* per annum, may be beneficially applied in the purchase of ground in a central situation, and in the erection thereon of a sufficiently spacious fireproof building for the Patent Offices and public free library attached thereto; and that the surplus fund may also be beneficially applied in the purchase of ground and the erection thereon of a permanent and spacious building for the Patent Office Museum, sufficient ground being taken for the extension of the building, from time to time, as may be required.

This is the more necessary, inasmuch as models of the most interesting and valuable description lie scattered over the kingdom, in many instances constructed at a great expense, for legal and other purposes, for which the owners have no present use, and many of which occupy a space inconvenient to them. These models, or many of them would, as the Commissioners confidently expect and believe, be presented or intrusted to them for exhibition in such museum, provided the public are allowed free access to it at all reasonable times.

The Patent Office is the place of constant daily and hourly resort of patentees, agents, and

and all others concerned in obtaining Patents, and in ascertaining what discoveries and improvements have already been made. It should be conveniently placed with reference to the Courts of Law, the Government offices, and the offices of the Attorney and Solicitor General.

With respect, however, to the proposed new museum, the Commissioners of Patents are of opinion that the same reasons for a central position do not exist, and that it might be placed upon any spot easily accessible to the inhabitants of the metropolis, and that the place in which the models are now exhibited would be an eligible position, sufficient ground being there purchased or assigned for the purpose. A large space will be required for the building in the first instance, and a larger extent must be provided for its future extension; and sufficient ground cannot be found in the centre of the town for a building of the extent required, unless at an enormous cost.

The Commissioners are anxious to establish a library in conjunction with the museum, showing the patents already granted by foreign Governments, and those which from time to time are so granted; and from the facilities afforded by foreign Governments the Commissioners have every reason to believe that this may be accomplished without difficulty.

These are the two objects which the Commissioners of Patents present to the consideration of the Lords Commissioners of Her Majesty's Treasury, and for which they are desirous to obtain their sanction:—

1st. The erection of a museum for the preservation and exhibition of the models, as above mentioned.

2nd. The erection of suitable offices.

The latter of these objects ought properly to precede the former, but if the offices they at present hold in Southampton Buildings can be retained for the present, this object may be postponed till a convenient site can be obtained.

For the accomplishment of the former object, a very favourable opportunity at present occurs, as the Lords of the Privy Council constituting the Committee of Trade are (as the Commissioners are informed) willing to allot to them a portion of the land recently purchased at South Kensington, sufficient in extent both for the purpose of the erection of the building now required and to provide for the future extension of the museum.

The Commissioners of Patents therefore request that the Lords Commissioners of Her Majesty's Treasury will be pleased to sanction the application of a sufficient portion of the surplus now derived from the fees paid on Patents for the purpose of accomplishing the objects above mentioned, and that with this view their Lordships will be pleased to give the necessary directions to Her Majesty's Board of Works to obtain a proper site for the proposed new Patent Office and Library, to be selected with the approbation of the Commissioners of Patents, and with the sanction of the Lords Commissioners of Her Majesty's Treasury, and also to prepare the necessary plans, elevations, and specifications for this purpose, also to be submitted to the Commissioners of Patents for their approval, and to make contracts for the building of the same when approved.

If their Lordships consent to these proposals, the Commissioners of Patents have to request that a sufficient sum for the purpose, so far as the same may be required for the year 1858-9, may be included in the estimate to be laid before Parliament in the present Session for Patent Office expenses.

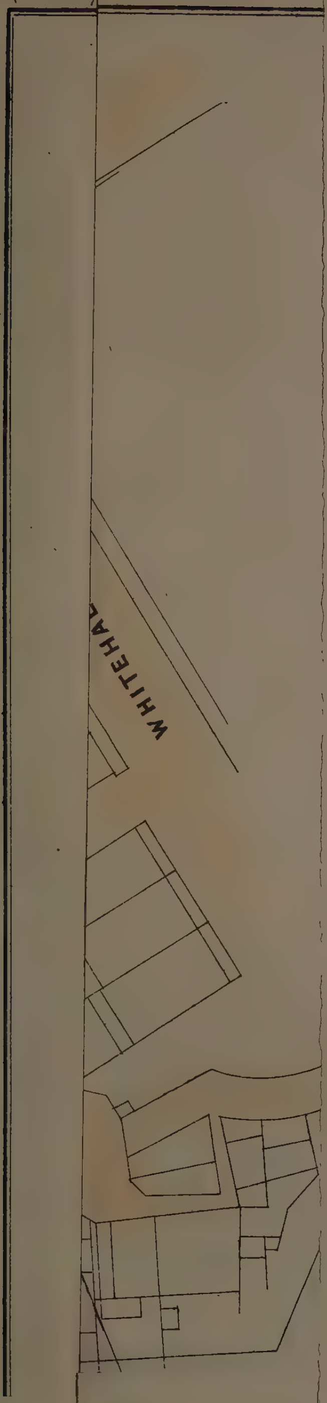
The Commissioners of Patents further brought the above subject to the notice of Parliament in their Report for the year 1858. In the Report to Parliament for 1859 (and those for 1860 and 1861), the Report to the Treasury was again embodied with these additional remarks:—

A Report of the Commissioners of Patents on building the Patent Office, Library, and Museum to the above effect was first transmitted to Her Majesty's Treasury in April 1858, and it was immediately thereafter referred by the Treasury to Her Majesty's Board of Works, with instructions to provide a convenient site for the proposed new offices and library, and to prepare plans and estimates to be laid before Parliament.

A site was found last year (1859) at the northern extremity of the Gardens of Burlington House, and plans and estimates were prepared, being a portion of a design for the appropriation of the whole of Burlington House Gardens for various public buildings. This plan has, however, been abandoned or suspended by the Government, and no other site has been found for the Patent Office buildings.

It is intended to make the Patent Office Museum an historical and educational institution for the benefit and instruction of the skilled workmen employed in the various factories of the kingdom, a class which largely contributes to the surplus fund of the Patent Office in fees paid upon Patents granted for their valuable inventions. Exact models of machinery in subjects and series of subjects, showing the progressive steps of improvement in the machines for each branch of manufacture, are to be exhibited; for example, it is intended to show in series of exact models each important invention and improvement in steam propellers [steamboat propulsion] from the first engine that drove a boat of two tons burden to the gigantic machinery of the present day, propelling the first-rate ship of war or of commerce. The original small experimental engine that drove the

(To face



th

la
C
P
C

The

s
he
act
of
for
nd
ve
the
ove

first-rate ship of war or of commerce. The original small experimental engine that drove
the

the boat of two tons burden, above referred to, is now in the museum, and is numbered one in the series of models of propellers.

The Commissioners are in possession of a large number of valuable models, remaining in their cases, for the reason that room cannot be found for exhibition in the very small space assigned to them in the Museum at Kensington; they are also, and for the same reason, obliged to postpone the acceptance of many valuable models offered as gifts by manufacturers and inventors.

The Public Library at the Patent Office is in the same condition; the books daily increase in number, and many remain in cases, for the reason that shelf room cannot be found, much less room for the readers.

The surplus of the fee fund applicable to building purposes amounted, at the end of 1859, to 46,000 *l.* (*vide* balance sheet); it will, undoubtedly, amount to 70,000 *l.* at the end of the current year (1860).

In 1862 the Commissioners again transmitted to the Treasury a Report on the subject, which included the first Report, with the following additional remarks:—

This report was, immediately on the receipt thereof by their Lordships, transmitted by them to Her Majesty's Board of Works with instructions that a convenient site should be provided for the proposed new offices, Public Library, and Museum, and also that plans and estimates should be prepared for Parliament.

In 1859 the Lords Commissioners of Her Majesty's Treasury and the Chief Commissioner of Her Majesty's Board of Works approved of a site for this purpose, lying at the northern extremity of the gardens of Burlington House; and thereupon plans and estimates were prepared for the new Patent Office and Library, by Messrs. Banks & Barry, the architects appointed by the Board of Works, which were so arranged as to form a portion of one complete design for the appropriation of the whole site of Burlington House and Gardens for various public buildings. This plan was, however, suspended or altogether abandoned on the change of Government in that year (1859), and no other site has been since provided for the Patent Office buildings.

The Public Library at the Patent Office is in the same crowded condition; the books daily increase in number, and many remain in cases, for the reason that shelf room cannot be found for the books, and still less accommodation for the readers.

The inconvenience arising from this source is accurately pointed out in a memorial presented to the Commissioners of Patents on the 22nd of July last, and signed by 46 gentlemen, consisting of eminent mechanical engineers, chemists, manufacturers, inventors and agents, who are readers in the Public Library of the Patent Office. A copy of the memorial, so far as it relates to this subject, is appended to this Report.

In connection with the erection of the necessary buildings for the objects above specified, a most important consideration is the spot to be selected for that purpose. The readers in the Library being of the class of scientific persons, barristers, mechanical engineers, chemists, inventors, skilled workmen in the various factories, solicitors, and Patent agents, it is obvious that the readers should be enabled to read the books and examine the machines and models at the same time and in the same place, and, consequently, that the Patent Office, Public Library, and Museum should be either under the same roof or in very close proximity, and also that the spot to be selected should be of easy access to the class of persons above referred to.

The proposed site for the Patent Office Buildings in Burlington House Gardens having been abandoned, as above stated, the Commissioners of Patents, in the following year (1860), proposed to your Lordships Fife House and Gardens in Whitehall, as a convenient site for the Patent Office Buildings and Museum, and one that would unite all the necessary requirements already referred to. This proposal was favourably considered, and a Minute of the Treasury was transmitted thereon to the Board of Works. It was found, however, that until the question of the embankment of the river and the roads of access to the main river-side road should have been settled by Parliament, no appropriation of that site for building purposes could be made.

This difficulty is now removed. The several roads have been set out and definitively fixed by the Thames Embankment Act of the present Session, and it is consequently now open to Her Majesty's Government, if it shall think fit to do so, forthwith to appropriate the site of Fife House for the erection of the proposed Patent Office Buildings.

The Crown leases of Fife House and the several buildings adjoining thereto have lately expired, and therefore the whole property is now at the disposal of Her Majesty's Commissioners of Woods and Forests in right of the Crown; and the Commissioners of Patents are informed that the site proposed can be obtained either by purchase or on a Crown building lease.

The

> The plan attached to this Report shows the road of access from Whitehall to the riverside main road, and the site proposed to be taken (the Patent Office, Library, and Museum marked A. and coloured red); also the land to be reclaimed by the Embankment (marked B. and coloured green) proposed to be reserved and appropriated for the extension of the Museum in future years.
>
> The surplus income of the Patent Office, applicable to building purposes, amounts in the aggregate to 129,000 *l.* The Commissioners of Patents do not propose to ask your Lordships to apply for building purposes any portion of this sum which has already been received and has formed part of the general revenue of the country, but merely that the surplus income of the present year (1862) and that of succeeding years should be applied for the purposes above enumerated.
>
> The surplus income of the current year (1862) is estimated at 40,000 *l.*
>
> The Commissioners of Patents therefore earnestly request that your Lordships will be pleased to sanction the appropriation of the site proposed by them for the Patent Office Buildings; that your Lordships will be pleased to give the necessary directions to Her Majesty's Board of Works to obtain the proposed site, either by purchase or by a lease from the Crown, and to direct the architects to prepare the necessary plans, elevations, and estimates; and further that your Lordships will be pleased to direct such plans, elevations, and estimates to be laid before Parliament at the commencement of the ensuing Session; and to apply for a Vote for such proportion of the estimated cost of the buildings as may be required for the year 1863–4; and should it be decided to purchase the land for the site, also to apply to Parliament for the sum of money necessary for that purpose, all such moneys to be repaid out of the surplus income for the current and succeeding years.

This new Report also appeared in the Reports to Parliament of 1862, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, and 1873.

From the commencement of the year 1853 numerous memorials, signed by legal, scientific, and literary men, have been sent to the Commissioners of Patents, pointing out the total unsuitability of the buildings now occupied as the Patent Office, Library, and Museum, and urging that a suitable building to accommodate the Patent Office, Library, and Museum on the same site should be erected out of the surplus funds arising from the fees paid by patentees.

In the Report of the Select Committee of the House of Commons on the Patent Office, Library, and Museum (19th July 1864), it is stated:—

> For this purpose suitable apartments for the Commissioners, law officers, and clerks, with a record office and rooms for inspecting provisional specifications, drawings, and scientific publications, should be at once provided.

Additional rooms having been built for a Library on the second floor of the Patent Office Building, the printed specifications, indexes, and scientific works were removed into them (without inconvenience to the general readers), and the Library was opened to the public on the 16th of April 1867. In the Report to Parliament for the year 1865 it is stated that "the building at present devoted to the purposes of the Patent Office, with the recent additions and alterations, is not now, nor can it ever be made to be suitable for the requirements of the office." Experience has proved this statement to be correct; the building is now filled, and there is a continual increase of specifications and scientific works, for which provision must be made.

CLERKS AND OFFICERS.

In January 1874 one of the Writers in the Patent Division was appointed an Extra Clerk, to fill the vacancy caused by the promotion in 1873 of one of the Extra Clerks to the Third Class in that Division.

In February one of the First Class Clerks in the Specification Division retired on a superannuation allowance. The vacancy thus created was filled by the promotion of the Senior Second Class Clerk in that Division; and the Senior Third Class Clerk was promoted to the Second Class.

In the same month the Curator of the Patent Office Museum died; and in the month of June following a gentleman was appointed to the vacant post.

In June also a gentleman was appointed to fill the vacancy caused by the resignation of one of the Third Class Clerks in the Patent Division.

AN ACCOUNT of the SALARIES paid to the Clerks and Officers appointed under the Act for the Year 1874.

	£.	s.	d.
Clerk to the Commissioners	1,000	–	–
Patent Division.			
Three First Class Clerks	1,305	8	11
Two Second Class Clerks	563	2	1
Three Third Class Clerks	391	15	7
Four Extra Clerks	603	12	–
Specification Division.			
Four First Class Clerks	1,721	15	7
Five Second Class Clerks	1,623	7	9
Eight Third Class Clerks	1,330	18	7
Two Extra Clerks	320	–	–
One Warehouse Keeper	130	–	–
One Warehouseman	90	–	–
Two Messengers	157	18	2
Library Clerk	400	–	–
Financial Clerk	450	–	–
Translator	500	–	–
Patent Office Museum.			
Curator	244	3	2
Assistant to Curator	174	16	8
£.	11,006	18	6

COMPENSATIONS.

In pursuance of several Awards and Minutes of the Lords Commissioners of the Treasury, under the provisions of the 50th section of the Act, allowing compensation to the undermentioned officers, the following sums have been paid out of moneys granted by Parliament for the purpose, for the Year 1874:—

	£.	s.	d.
To the Attorney General for Ireland	1,136	13	4
To the Solicitor General for Ireland	800	–	–
To the Lord Advocate for Scotland	850	–	–
To the Clerk of the Attorney General for Ireland	283	6	8
To the Clerk of the Lord Advocate for Scotland	300	–	–
£.	3,370	–	–

CURRENT AND INCIDENTAL EXPENSES.

The 49th Section of the Act empowers the Lords Commissioners of the Treasury to allow the necessary sums for providing offices under the Act, for the fees, salaries, and payments to be allowed, and for the current and incidental expenses of the office, to be paid out of such moneys as may be provided by Parliament for the purpose.

AN ACCOUNT of the CURRENT and INCIDENTAL EXPENSES in the Office of the Commissioners for the Year 1874.

	£.	s.	d.
Paid office keeper	185	–	–
Paid writing and copying clerks in the office, and library servants	3,347	16	11
Paid Mr. Carey for indexing "Commissioners' Journal"	67	11	6
Paid Mr. Walenn for abridging specifications relating to hydraulics, optical instruments, harbours, &c.	227	1	–
Paid Mr. Wood for abridging specifications relating to ships' rigging, anchors, steering vessels, &c.	248	17	–
Paid Mr. Birch for abridging specifications relating to metallic pipes, casks and barrels, fire engines, &c.	210	1	–
Paid Mr. Hardy for abridging specifications relating to wearing apparel, &c.	234	2	–
Paid Mr. Healey for abridging specifications relating to mining and tunnelling sewers and drains, &c.	81	18	–
Paid metropolitan police	483	5	–
Paid insurance on stock of printed specifications and models in museum	69	17	6
Paid wages in the Patent Office Museum	570	18	–
Paid incidental expenses (office and museum)	331	18	7
£.	6,058	6	6

The Commissioners have thought it expedient to lay before Parliament in the Schedule to this Report an account of stamp duties in lieu of fees received under the provisions of the Act, with a balance sheet of receipts and expenditure.

SCHEDULE.

AN ACCOUNT of STAMP DUTIES received under the Act to substitute Stamp Duties for Fees (16 Vict. c. 5), for the Year 1874.

		£.	s.	d.
4,492	petitions for grant of Letters Patent, at 5*l.* each	22,460	–	–
3,432	notices of intention to proceed with application, at 5*l.* each	17,160	–	–
32	notices of objection to the grant of Letters Patent, at 2*l.* each	64	–	–
7	,, ,, sealing do. do.	14	–	–
3,167	warrants for patents, at 5*l.* each	15,835	–	–
3,162	patents sealed, at 5*l.* each	15,810	–	–
2,868	final specifications filed, at 5*l.* each	14,340	–	–
242	complete specifications filed, at 5*l.* each	1,210	–	–
917	entries of assignments of patents and licenses, at 5*s.* each	229	5	–
1,074	searches and inspections, at 1*s.* each	53	14	–
6,176	folios of office copies of documents, at 2*d.* per folio	51	9	4
819	patents upon which the progressive stamp duty of 50*l.* has been paid	40,950	–	–
257	patents upon which the progressive stamp duty of 100*l.* has been paid	25,700	–	–
18	duplicate patents issued in lieu of original patents lost or destroyed, 5 *l.* each	90	–	–
18	petitions on application for disclaimers, 5*l.* each	90	–	–
4	caveats against disclaimers, 2*l.* each	8	–	–
3	new patents granted upon Her Majesty's Order in Council under the 40th section of the Act (1852)	15	–	–
	£.	154,080	8	4

BALANCE SHEET OF INCOME AND EXPENDITURE

For the Year 1874.

RECEIPTS.	£.	s.	d.	PAYMENTS.	£.	s.	d.
Stamps duties under 16 Vict. c. 5 - - - - -	154,080	8	4	Salaries of the officers and clerks in the Patent Office - -	11,006	18	6
By stamp duties on sale of printed specifications, &c. -	2,310	3	–	Compensations - - -	3,370	–	–
				Current and incidental expenses in the Patent Office and Patent Office Museum - - -	6,058	6	6
				Cost of stationery supplied by Her Majesty's Stationery Office, books for the free library, and binding, &c. -	1,171	–	–
				Rent of offices, rates and taxes -	607	9	6
				Messrs. Eyre and Spottiswoode for printing specifications of patents, indexes, &c., and lithographer's bills for drawings accompanying specifications; and miscellaneous printing - - - -	20,749	–	–
				Cost of paper supplied to the printer and lithographer by Her Majesty's Stationery Office - - - - -	2,152	–	–
				Cost of coals and other fuel supplied to the Patent Office by Her Majesty's Office of Works, and furniture and repairs - - - -	657	2	7
				*Surplus Income for the year 1874 (including 29,165 l. Revenue Stamp Duty, as stated below †) - - -	110,618	14	3
£.	156,390	11	4	£.	156,390	11	4

---

* The aggregate surplus income, on balance of accounts from the 1st October 1852 to the end of the year 1874, amounts to the sum of 1,218,822 l.

† The Act of 1852 in lieu of the old duties upon patents imposed a revenue stamp duty of 5 l. upon the warrant of the law officer, 10 l. upon the certificate of payment of the progressive fee of 40 l. at the expiration of the third year, and 20 l. upon the certificate of payment of the fee of 80 l. at the expiration of the seventh year of the patent.

The Act of 1853 (16 Vict. c. 5) converted all the fees imposed by the Act of 1852 into stamp duties.

The revenue stamp duty account for the year 1874 is as follows:

	£.	s.	d.
3,167 warrants of the law officers for patents, at 5 l. each - -	15,835	–	–
819 patents on which the progressive duty of 50 l. has been paid at the end of the third year from their respective dates (10 l. being revenue stamp duty and 40 l. fee stamp duty), 819 at 10 l. each - - - - - - - - -	8,190	–	–
257 patents on which the progressive duty of 100 l. has been paid at the end of the seventh year from their respective dates (20 l. being revenue stamp duty and 80 l. fee stamp duty), 257 at 20 l. each - - - - - - - - - -	5,140	–	–
£.	29,165	–	–

CAIRNS, C.
G. JESSEL, M.R.
R. BAGGALLAY, A.G.
JOHN HOLKER, S.G.

Dated the 3rd August 1875.

PATENTS FOR INVENTIONS.

REPORT

OF THE

COMMISSIONERS OF PATENTS FOR INVENTIONS,

1874.

(*Presented pursuant to Act* 15 & 16 *Vict. c.* 83.)

Ordered, by The House of Commons, *to be Printed*,
4 *August* 1875.

[*Price* 1*s.* 2*d.*]

392.

Under 3 *oz.*

Vol. 27. pp 121–666.

[C. 1264] Science & Art. Twentysecond Report of the Science & Art Department of the Committee of Council on Education.

For this Report see the Volume lettered XXVII Octavo Portions

66

ANNUAL REPORT

OF THE

VETERINARY DEPARTMENT

OF THE

PRIVY COUNCIL OFFICE

FOR THE

Year 1874,

WITH

AN APPENDIX.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

[C.–1321.] *Price* 1*s.* 3*d.* 1875.

Veterinary Department,
Privy Council Office,
29th June 1875.

Sir,

In accordance with the instructions of the Lord President, I have the honour to forward the accompanying Report of the Veterinary Department for the year 1874, with an Appendix, containing a Report by the Chief Inspector of the Department, and translations and Returns relating to Home, Irish, and Foreign Animals, and their diseases.

I have the honour to be,
Sir,
Your obedient Servant,
ALEXANDER WILLIAMS,
Secretary.

The Clerk of the Council.

CONTENTS.

REPORT - - - - - - - - pp. 5 to 12

APPENDIX - - - - - - - „ 13 to 39

„ Statistical Tables - - - - - „ 40 to 120

REPORT.

LEGISLATION DURING THE YEAR 1874, RELATING TO CONTAGIOUS OR INFECTIOUS DISEASES OF ANIMALS IN GREAT BRITAIN.

THE Privy Council, under the powers conferred upon them by The Contagious Diseases (Animals) Act, 1869, have, during the past year, only found it necessary to issue three Orders, reprints of which will be found in the Appendix. *See* page 31.

The first of these, entitled The Schleswig-Holstein Order of 1874 (No. 370), had practically the same effect as the similar Order of the previous year, and relieved for a time the cattle brought from Schleswig and Holstein from the provisions of the Fourth Schedule to the Act; allowing these cattle, after not less than 12 hours' detention at the landing-place, and after receiving a certificate from one of the Inspectors of the Privy Council that they were not affected with any contagious or infectious disease, to be moved as if they were Home stock.

The Schleswig-Holstein Order of 1874 was, however, issued considerably earlier than that of previous years in consequence of the representations of those interested in the trade to the effect that the producers in these Duchies had prepared their cattle for the market at an earlier period than heretofore. These representations do not, however, appear to have been correct, as, although the Order was in force from the 1st of March, only 419 cattle were brought to this country between the above-mentioned date and the last week in June, whilst, between the latter date and the 30th of November, at which date the Order ceased to be in operation, 44,317 cattle from these duchies were landed in Great Britain.

The second Order issued by their Lordships in 1874 is entitled The Foot-and-Mouth Disease Order of 1874 (No. 371), and was considered necessary owing to the existence of foot-and-mouth disease in various districts, and to a wish very generally expressed that local authorities should again have power to make regulations for the purpose of checking this disease. This Order practically re-enacts the powers conferred on local authorities by The Animals Order of 1871, which were rescinded by The Animals (Amendment) Order of 1873. During the year the local authorities of the Metropolis, thirty-eight counties, or divisions of counties, and thirteen boroughs in England and Wales, and nine counties and one burgh in Scotland made regulations under this Order.

The third Order, called The Animals (Amendment) Order of 1874 (No. 372), was principally for the purpose of interpreting certain points upon which doubts had been expressed, and for amending the Order relating to glanders.

CONTAGIOUS OR INFECTIOUS DISEASES AMONGST ANIMALS IN GREAT BRITAIN.

A professional report by the Chief Inspector of the Department relating to these diseases will be found at page 15. This country has been free from cattle plague and sheep-pox during the past year; sheep-scab and glanders have prevailed to a more or less extent in England, Scotland, and Wales. Table XII.

Pleuro-Pneumonia.

Pleuro-pneumonia has prevailed in England and Scotland during the year, but not a single case has been reported from Wales. Table XIII.

It may be remembered that on the 1st of September 1873, the slaughter of cattle affected with this disease was made compulsory, and it was remarked in the Report for that year that the Order had been too short a time in operation to show its effects.

This Order has now been in existence for such a length of time that, if it has been duly carried into effect, satisfactory results should by this time have appeared.

The number of outbreaks which were reported upon during 1874 was 3,262 in Great Britain against 2,711 in 1873, and the number of cattle attacked was 7,740 in 1874, and 6,787 in 1873, shewing an increase in 1874 over 1873 of 953 cases. This increase probably arises, partly from the disease being more readily reported, now that compensation is paid, and partly from the increase in the number of cattle. Table VIII.

It appears, then, from the annual return that there has been not only no decrease but an increase in the number of cases reported with regard to this disease since slaughter was made compulsory. But if we take the first complete quarter during which the Order was in force, and compare it with the corresponding quarter of the following year, we shall find that in the quarter ended December 1873 there were 2,357 cases, whilst in that ended December 1874 the number was 1,381, being a decrease of 976 cases, or rather more than 41 per cent. for the quarter.

It is to be hoped that this is the commencement of a steady decrease in the disease, and that next year's returns will show that this has continued.

Since the slaughter of cattle affected with pleuro-pneumonia has been made compulsory, the question whether the carcases of animals so slaughtered are fit or unfit for human food has arisen. As The Contagious Diseases Animals Act, 1869, does not contain any provisions either relating to food or to the disposal of such carcases, the Local Government Board were consulted on this matter. A copy of correspondence on the subject will be found at page 34, by which it will be seen that the present state of the law is not satisfactory on the point. A correspondence on the same subject with the Admiralty is also added.

The success in checking pleuro-pneumonia by isolation which attended the experiments referred to in the Chief Inspector's Report, and in other cases, induced the Lords of the Council to recommend a similar system to the local authorities. Accordingly, in January 1874, a circular letter was forwarded to local authorities, setting forth the method suggested by the Chief Inspector, by which the slaughter and isolation could be carried into effect. A copy of this circular letter will be found at page 36.

It is not known to what extent the local authorities have followed the suggestions contained in that circular, and, therefore, the effect of carrying them out cannot be estimated. The scarcity of veterinary surgeons amongst the inspectors, qualified to use the thermometer properly, no doubt has, to some extent, prevented the general application of the temperature test to this disease.

Inoculation has not as yet been satisfactorily proved to have a protective influence in this disease. It is to be regretted that means have not been taken for the purpose of settling this point; but there exists no fund at the disposal of this Department out of which the expense of any such experiments could be paid.

In September 1874 a circular letter was issued requesting the local authorities to furnish a record for the twelve months ending the 31st of August 1874, in accordance with the record ordered by Article 34 of The Animals Order of 1871 to be kept by local authorities, of each head of cattle affected with pleuro-pneumonia slaughtered by their order in pursuance of Article 3 of The Animals (Amendment) Order of 1873.

From the replies received up to the date of this Report it appears that the number of cattle slaughtered by order of local authorities in Great Britain between 1st of September 1873 and the 31st of August 1874, both days inclusive, was 6,898, and the amount of compensation awarded was 44,384*l.* 11*s.* 2½*d.* A Return for the various districts will be found at page 36.

Foot-and-Mouth Disease.

Returns of cases of foot-and-mouth disease have not been furnished to the Privy Council Office during the past year by the inspectors of the local authorities.

On the 22nd June a circular letter was forwarded to all the local authorities, and was repeated on the 15th July, requesting to be informed whether foot-and-mouth disease existed in their respective districts, and whether it was contemplated to make any regulations under The Foot-and-Mouth Disease Order of 1874.

Considerable difficulty and delay occurred in obtaining answers to the above-mentioned circulars; but, from information received from about three-fourths of the local authorities to whom such circulars were addressed, it would appear that at that time foot-and-mouth disease did not prevail to any great extent in Great Britain.

An inspector of this Department was sent down to some of the places where the disease appeared to be especially prevalent, with a view to ascertain the extent of the outbreaks, and the precautions taken; but no additional particulars of importance were obtained.

FOREIGN COUNTRIES.

1. *Proposals for International Communications with respect to Cattle Plague.*

In order to understand the position of the various countries in this matter, it appears desirable, before stating what has been done during the past year, to recapitulate what had been done in previous years.

It may be recollected that, on account of the prevalence of cattle plague in 1865–66, the various European Governments found it necessary to impose such severe restrictions on the import of cattle from one country to another, and on the transit of cattle within their dominions, that the home and foreign cattle trade of all these countries was seriously interfered with. It was, therefore, of international importance to reduce the restrictions on the trade to the minimum which would be sufficient to check the disease. For the purpose of arriving at some conclusion upon this point a Veterinary International Congress was held at Vienna in 1865.

The most important conclusion arrived at on that occasion was the resolution that, considering the time of incubation of cattle plague, a quarantine of 10 days of store animals from Russia was sufficient to prevent the introduction of the disease into any country. It had been found that the quarantine of 21 days was a great impediment to trade, and led to frequent evasion of the law, infected animals being smuggled across the frontier.

In 1867, another Congress of a similar nature was held at Zurich, at which about 170 delegates were present. At this meeting the opinions expressed at the former Congress were confirmed, and resolutions of a more detailed character were agreed to, but no suggestions of an international character were decided upon. The Lords of the Council were, at a very early period, impressed with the importance to this country of *immediate* information of all outbreaks of cattle plague in neighbouring countries. Cattle affected with cattle plague had been landed in this country from foreign countries from which no information had been received of the existence of the disease, and thus the danger existed that cattle plague might be introduced among our home cattle even indirectly, as, at a later time, it was introduced at Hull.

In 1868, therefore, their Lordships requested the Foreign Office to instruct their consuls abroad to report immediately by telegraph whenever a fresh outbreak of cattle plague occurred, and to continue to make weekly reports so long as the disease existed. From countries free from the disease the consuls were instructed to report the fact monthly. The information thus obtained has been, on many occasions, of great service. In the same year an arrangement was entered into between France and this country, to afford reciprocally immediate information of outbreaks of cattle plague.

It is of especial importance to this country to obtain the earliest information of outbreaks of cattle plague, as the home production of cattle is unable to supply the demand, whilst the foreign supply is only limited by cost of production and of transit, (except in those cases where prohibition or restriction is placed upon the traffic,) and the more so, as the powers of the Privy Council, assisted by the insular position of this country, would enable their Lordships, more effectually, perhaps, than any other authority in Europe, to prevent the direct introduction of the disease, if they knew of its existence in time to prohibit the landing of animals from infected districts. Hence the importance of *direct telegraphic information.*

No further step to attain this end appears to have been taken until 1871, when the Government of Austria-Hungary proposed and arranged for an International Conference, which was held at Vienna, for the purpose of recommending the principles of an International Regulation for the extinction of cattle plague. As already stated in my Report for 1872, this Conference met in March 1872, under the presidency of His Excellency Johann Ritter von Chlumecky, Royal Imperial Minister of Agriculture for Austria, and comprised 26 delegates, who represented Austria, Belgium, Germany, France, Great Britain, Hungary, Italy, Roumania, Russia, Switzerland, Servia, and Turkey.

Since 1872, the Imperial and Royal Government of Austria have taken the initiative in the executive, as they had previously done in the calling together of the Conference. Accordingly, in March 1873, a copy of a note from the Austrian Ambassador was received, stating that his Government had provisionally sanctioned a mode of proceeding for carrying out the principles involved in Article I. of the International Resolutions; such mode to serve as a basis for a future definite agreement among the various Governments on the subject of exchanging official information as to cattle plague. The Lords of the Council gave this note, and the other correspondence relating thereto, their careful consideration, and decided that it would be advisable that the assent of this country should be given to the principles laid down in Article I. above referred to, but that, as regards the mode of proceeding, their Lordships were doubtful whether the terms used in Nos. 1 and 3 of such mode would include this country, owing to its insular position.

See page xx. of Report for 1872.

Such was the state of the correspondence at the end of 1873. It has, however, been continued during the past year, and the Government of Austria-Hungary have still continued to take the initiative. At the end of 1873, so far as regarded this matter, the

Government of this country had assented generally to Article I. of the proposed International Resolutions, which refers more particularly to rapid international communication respecting cattle plague; but had raised objections to the mode of proceeding proposed by the Government of Austria-Hungary for carrying out the object of such article. The Privy Council were induced to raise these objections to the mode of proceeding proposed, as they were under the impression that, on the approval of such mode by all the Governments represented at the Vienna Conference, it might have formed the basis of a more formal document or convention. Their Lordships, therefore, suggested such a modification of its clauses as would meet the views of the Privy Council in the matter. At the end of the year 1874 the correspondence with Austria-Hungary relating to this matter was still proceeding.

The Department has also been in communication, through the Foreign Office, with other Governments with a view to carry out this principle of rapid international communication relating to cattle plague, but no final arrangements have been made officially with any of them.

2. *Legislation in various Countries.*

tria-
gary.

In March 1874, Hungary issued some regulations intended to check the spread of cattle plague in that country, of which a translation will be found at page 22. Hungary, as well as Austria, seems to be doing its utmost to eradicate the cattle plague, or at least keep it within moderate bounds; and it is upon the efficiency of the means taken in these countries that the United Kingdom must mainly depend for a reduction in the risk of the introduction of cattle plague into it, for, although we do not directly import from them, their cattle go to supply the countries from which we import, and any check on their trade has a similar effect upon ours.

In addition to the above-mentioned regulations perhaps the most important legislation with regard to contagious or infectious diseases of animals which has taken place in Europe for some years is the Act which became law in Hungary in July 1874. This Act is the latest result of the inquiries and experience of many years, and appears to be carefully drawn with a view to adopt the latest European experiences. A translation of it is given in the Appendix at page 22.

As already mentioned, Austria has been the most active European country in endeavouring to bring about International Regulations for relieving the restrictions on the cattle trade, and at the same time for preventing the spread of cattle plague; and it now appears probable that these exertions will be eventually attended with success, not only as regards itself, but also as regards other cattle plague infected countries.

Although this disease has, during the year 1874, occurred in a number of districts in Hungary, yet it was, at times, more nearly eradicated in that year than it had been for many years; and when it is considered that the new Act did not come into operation until the latter half of 1874, there appears to be every reason to hope that its provisions will eventually have a marked effect in checking the disease.

ium.

The Department has received no information as to any change in the laws relating to diseases amongst animals in Belgium, nor has it received any report that either cattle plague, pleuro-pneumonia, foot-and-mouth disease, sheep-pox, sheep-scab, glanders, or farcy have existed in that country during the past year. That foot-and-mouth disease has existed there, however, is certain, as 206 cattle and 136 swine affected with that disease were received from Belgium during 1874. The total imports from that country during the same period was 1,086 cattle, 108,193 sheep, and 1,552 swine.

eXLIX.
e
XVII.

mark.

No changes have been reported in the regulations relating to Denmark during 1874, except with regard to modifications respecting the import of cattle into Denmark from Schleswig and Holstein. By the law of the 13th of February 1873, all ruminating animals imported into Denmark from France and Germany (including Schleswig and Holstein) had to undergo three weeks quarantine. After a correspondence with the Privy Council the three weeks quarantine was not required as regards ruminating animals imported into Denmark from Schleswig and Holstein, provided that they were accompanied with a certificate of health, and a declaration that they were bred in the Duchies, and had never left them, and had never been brought in contact with foreign cattle which were not so born and bred.

ce.

The only notice of regulations received from France during the year, has reference to a local order, by which the Prefet of La Manche prohibits the introduction into that department of horses, asses, and mules from the Isle of Jersey on account of cases of glanders having appeared in that island.

Germany.

During the past year Germany has again urged upon this Government the removal of the restrictions which exist in this country upon the import of German cattle. In July the application was made for the relief of cattle brought here from the Duchy of Oldenburg, which cattle it was proposed should be admitted under similar restrictions to those under which cattle brought from Schleswig and Holstein had been admitted for some time for a certain part of each year. The Lords of the Council considered that, pending the negociations relating to the proposed International Regulations on these matters, and the different geographical position of Oldenburg compared with Schleswig and Holstein, they were not justified in granting the relaxation asked for. Later in the year the German Government again entered into negociations with this country with a view to the removal of the restrictions in this country on the importation of cattle from German ports. After careful consideration a reply was sent, stating that their Lordships regretted that, having regard to the safety of the cattle in this country, and the present state of the cattle plague in Europe, they did not then feel justified in entertaining the question. A further application of a similar nature was received in December urging that, on account of the German legislation relating to cattle plague, the German empire must be considered as essentially better secured against the introduction and propagation of the disease than is the case with other countries. This letter was under consideration at the end of the year.

Germany remained free from cattle plague in 1874, but pleuro-pneumonia, sheep-pox, sheep-scab, and glanders were reported to have existed there. Last year 57,368 cattle, 305,186 sheep, and 13,527 swine were received from Germany, of which 1 head of cattle was affected with pleuro-pneumonia; 220 cattle, 40 sheep, and 141 swine were affected with foot-and-mouth disease; and 67 sheep were affected with sheep-scab. Germany is still a scheduled country, but the duchies of Schleswig and Holstein were excepted under special Order of Council during nine months in the year.

Table XXXVII.
Table XLIX.

Greece.

Cattle plague has existed during the greater part of the last year in different parts of Greece, and although no cattle are, or are likely to be, received from that country, there is danger that it may be the means of communicating the disease to other places more immediately connected with this country by the cattle trade. Greece is a country placed in the schedule under which any cattle coming therefrom must be slaughtered at the landing-place.

Italy.

Italy has also been visited by the cattle plague during the past year, and has made regulations both with regard to the import of animals and to prevent the spreading of the disease. As, however, no cattle are, or are likely to be, received direct from that country, and this country has to depend more upon the precautions taken in those countries through which cattle from Italy might come, the details of the restrictions made with a view to prevent the spreading of cattle plague in that country need not be dwelt upon.

Netherlands.

The Department has received no information of any change having taken place during the year in the legislation of the Netherlands with respect to contagious or infectious diseases of animals. Reports have been received from time to time from that country as regards the effects produced by legislation there. An analysis of the results of the treatment pursued will be found at page 15, from which it would appear that the system which is being tried in the Netherlands for the purpose of eradicating pleuro-pneumonia has not been attended with the success which was anticipated.

The only disease reported to have existed in the Netherlands during the past year has been pleuro-pneumonia; but, in addition to 1 head of cattle affected with this disease, 4 sheep and 414 swine affected, with foot-and-mouth disease were landed in Great Britain, out of a total import from that country of 66,606 cattle, 324,488 sheep, and 49,740 swine.

Table XLIX.
Table XXXVII.

Portugal.

From Portugal no new regulations or laws relating to contagious or infectious diseases of animals have been received during the past year, nor have any reports of any disease other than foot-and-mouth disease been received. During the year 995 cattle affected with foot-and-mouth disease were landed from Portugal, but no animal affected with any other contagious or infectious disease was imported, although 12,412 cattle, 4 sheep, and 61 swine, were received from Portugal, which is an unscheduled country.

Table XLIX.
Table XXXVII.

Russia.

The import into this country of cattle from Russia has been prohibited since July 1872, so that any Russian regulations would only indirectly affect this country. The laws of that country, however, do not appear sufficient to check the cattle plague to any considerable extent, as the disease appears to continue year by year, notwithstanding the measures which are taken.

Spain.

No regulations have been received from Spain relating to contagious or infectious diseases of animals, nor has any information been received during the year with respect to sheep-pox, which was reported to have existed in that country during 1873. It may be assumed that these diseases were not prevalent there, as during the year 16,509 cattle, 113 sheep, and 4 swine were landed in Great Britain, none of which were found to be diseased.

ble
XVII.

eden and
rway.

Neither have any regulations been received from Sweden or Norway relating to these diseases, nor any intimation that any of them exist in either of these countries.

ble
XVII.

From Norway 1,121 cattle and 168 sheep, and from Sweden 8,704 cattle, 1,799 sheep, and 381 swine, have been imported into this country, and not a single case of disease has been detected amongst them.

ica and
rkey.

Cattle plague has been reported during the year in Abyssinia, Turkey in Europe, and Turkey in Asia, but no information has been received as to the methods employed to prevent its spreading.

COLONIES.

stralia
l New
aland.

At an International Conference held at Sydney, New South Wales, in January and February 1873, it was resolved, in consideration of the great danger to which Australian live stock were exposed from the importation of animals from infected countries, that it was expedient to prohibit the landing of cattle, sheep, and pigs from places beyond the Australasian colonies, and it was agreed that such animals should be prohibited from being landed at New South Wales, New Zealand, Queensland, South Australia, Tasmania, Victoria, and Western Australia for a period of two years.

Of these colonies, New South Wales, Queensland, South Australia, Victoria, and Western Australia accordingly prohibited the importation of animals from places beyond the Australian colonies; but it appears that the Government of New Zealand had not, under existing Acts, power to prohibit such importation. A Bill was therefore laid before the New Zealand Parliament to enable the Government to do so, but it did not pass. Thereupon the other colonies, above-named, prohibited the importation of animals from New Zealand.

The Legislature of New Zealand afterwards passed an Act, dated 2nd October 1873, to the effect that animals from a foreign district should not be landed in New Zealand without a certificate as to their freedom from disease before shipment, and should only be landed at ports named by the Local Cattle Board or by the Governor.

IMPORTATION OF ANIMALS.

le
XIII.

The importation of foreign animals into Great Britain during the year 1874 was, on the whole, less than that of 1873; the cattle shewing a decrease of 5,872, and the sheep shewing a decrease of 92,354, whilst the importation of swine increased by 35,391 head.

le
XII.

The importation from Ireland also decreased by 133,409 cattle and 20,036 swine, but increased in the number of sheep by 139,539 head.

In the Report of the Department for 1872, page xxv, data were set forth upon which the estimated relation which the foreign supply of live cattle bears to the total supply was shewn; and, on calculating the relative proportions furnished from each of the sources of supply for the succeeding years upon the same basis, they will be found to be as follow:—

	1871.	1872.	1873.	1874.	
	—	—	—	—	
Home supply, about -	57½	55¾	54¾	61¾	per cent.
Irish do. do. -	28	34½	35	28¼	„
Foreign do. do. -	14½	9¾	10¼	10	„

Upon an estimate based on similar data being made with respect to the number of home cattle available for consumption in 1874, taken together with the imports in that year of Irish and foreign cattle, it is found that, although the home production, so estimated, appears to have increased, there was a falling off in the total number of cattle available for consumption in Great Britain in 1874.

bles
II.,
l LVIII.

The falling off is remarkable, as although there was an increase in the number of sheep and swine imported, and an increase in the estimated home supply of sheep available for consumption, there was a decrease in the estimated number of swine so available, as well as a decrease in the import of dead meat, and this, with the deficiency above referred to in the supply of cattle, shews the total supply of meat to have been less; so that, so far as it can be ascertained, the conclusion is inevitable, that, without considering increase of population, the consumption of meat per head during the past year has been less than in the previous year, which may probably in part be accounted for by the disturbance in the labour market.

PRICE OF MEAT.

As the meat supply per head required in this country during the past year does not appear to have been so large as in previous years, it would naturally follow from the laws which govern demand and supply that the wholesale prices of meat should fall. This appears to have been the case, as the average prices for the past year of all live meat at the Metropolitan Cattle Market were reduced to the following extent:—

	1873.		1874.					
	d.		*d.*				*d.*	
Beef from	$8\frac{17}{32}$	to	$8\frac{1}{16}$,	being a reduction	in 1874	of	$\frac{15}{32}$	per lb.
Mutton ,,	$9\frac{13}{32}$	,,	$8\frac{1}{32}$	,,	,,	,,	$1\frac{3}{8}$	,,
Pork ,,	$6\frac{7}{8}$	,,	$6\frac{11}{16}$	,,	,,	,,	$\frac{3}{16}$	,,
Veal ,,	$8\frac{11}{32}$	,,	$7\frac{29}{32}$	,,	,,	,,	$\frac{7}{16}$	,,
Lamb ,,	$11\frac{7}{8}$	,,	$10\frac{1}{2}$	,,	,,	,,	$1\frac{3}{8}$	,,

Table III.

The decrease in the price of mutton and lamb was considerable, amounting in the former case to upwards of 14, and in the latter to upwards of 11 per cent. Yet the consumer does not appear to have benefitted from this reduction in price. In the Report of this Department for 1871 it was stated that no direct connection had then been shown to exist between the wholesale price of meat and the price which the ordinary consumer is required to pay for it. This statement appears still to be true as regards reduction in the wholesale price; for, although any increase in the wholesale price is invariably brought forward as an evidence of the necessity for increasing the retail price, a decrease in the former is not, so far as evidence has been obtainable, followed by a like reduction to the consumer. It is to be feared that so long as choice in selection of special joints exists, fancy prices will be paid for meat; and so long as a good profit is required by the middle-man, as well as by the salesman and the wholesale and retail butcher, both the producer and the consumer must suffer.

INSPECTION.

Departmental Inspection.

The staff of inspectors attached to the Department has received an addition during the past year in the appointment of Mr. Courtney as travelling inspector, whose duties consist in visiting all parts of the country, and, with the assistance of the local inspectors, in ascertaining that the Orders of Council relating to the transit of animals, both as regards disinfection and the prevention of cruelty and suffering, and those relating to the vessels engaged in the Irish and coasting, as well as in the foreign trades, and to railways, lairs, markets, and fairs, are efficiently carried into effect.

Inspection of Irish and Foreign Animals, Railways, &c.

There have also been added to the staff of the Department during the past year ten inspectors, who are stationed at the ports at which Irish cattle are landed, and who are instructed to inspect, as far as practicable, all animals (including horses) landed from Ireland, and if any contagious or infectious disease is detected in any such animals, they are forthwith to report the fact to the Veterinary Department and to the local authority.

The inspectors of foreign animals at the various ports are also similarly instructed, and all these local inspectors have instructions to inspect vessels, and the trucks, pens, &c. used on railways for the transit of animals, and to report any neglect on the part of any person in carrying into effect the provisions of the Act of 1869 or of any Orders of Council thereunder.

Inspection under Local Authorities.

The local authorities had for the purposes of The Contagious Diseases (Animals) Act, 1869, 1,706 inspectors holding appointments on the 31st of December 1874. Of these 371 were veterinary surgeons, 1,021 were officers of police, and 314 appear to have possessed no special qualification for the office.

Returns, &c.

The inspectors of the Privy Council, and the inspectors and other officers of the local authorities, have furnished to the Department 32,808 papers requiring treatment, in addition to the correspondence which is registered separately.

ALEXANDER WILLIAMS.

Veterinary Department,
Privy Council Office,
29th June 1875.

APPENDIX.

APPENDIX.

CONTENTS.

	pages
Report on Contagious and Infectious Diseases of Animals - - - By the Chief Inspector of the Department.	15 to 21
Translation of Regulations issued by the Hungarian Minister of Commerce relating to Cattle Plague - - - - - - - - -	22
Translation of an Act passed in 1874 by the Hungarian Diet relating to Cattle Plague	22 to 27
Foreign Countries in which Contagious or Infectious Diseases amongst Animals were reported to have existed in the year 1874 - - - - - -	28 to 29
List of Orders of Council in operation on the 31st December 1874 - - -	30
Countries comprised in the Second Schedule to The Foreign Animals Order of 1871 -	30
Ports in Great Britain at which Foreign Animals may be landed - - -	30
Orders of Council issued during the year 1874 under The Contagious Diseases (Animals) Act, 1869 - - - - - - -	31 to 33
Correspondence relating to the Fitness for Human Food of the Flesh of Animals slaughtered on account of Disease - - - - - - -	34 to 35
Circular Letter issued to Local Authorities on the Subject of Slaughter and Isolation in cases of Pleuro-pneumonia - - - - -	36
Return of the Number of Cattle slaughtered on account of Pleuro-pneumonia during the Twelve Months ending 31st August 1874, and the Amount of Compensation awarded - - - - - - - -	36 to 39
Statistical Tables - - - - - - - - -	40 to 120

APPENDIX.

APPENDIX.

REPORT on the CONTAGIOUS and INFECTIOUS DISEASES of ANIMALS referred to in The Contagious Diseases (Animals) Act, 1869, especially with respect to their degree of prevalence in 1874, by the Chief Inspector of the Veterinary Department.

PLEURO-PNEUMONIA.

Pleuro-Pneumonia.

No outbreak of cattle plague or sheep-pox occurred in the Kingdom during the year 1874, it will, therefore, only be necessary to refer to the other contagious or infectious diseases of animals, pleuro-pneumonia, foot-and-mouth disease, sheep-scab, glanders, and farcy.

The causes which contribute to the spread of pleuro-pneumonia were referred to in the report for the year 1873, and there is nothing to add to the statements which were made, the disease continues to prevail, apparently without being influenced in any important degree by the means which have been employed to arrest its course. According to the return for 1874 the number of animals attacked with the disease during the year was 7,740. In the previous year the number was 6,787, so that if the returns indicate the actual state of prevalence of disease the establishment of a system of compulsory slaughter has been followed by an increase of the number of attacks. There is no reason, however, to conclude that the slaughter of diseased animals has affected the spread of the disease in any way, nor is it probable that the partial adoption of the system, independently of the strict isolation and careful supervision of infected animals, will ever be attended with beneficial results.

In the Netherlands, where a much more rigorous system of treatment has been carried into effect for some time past, the number of attacks has materially diminished, but the disease is yet far from being eradicated, and, considering the severity of the measures used, and the circumstance that the country does not import cattle, the results which have been obtained are not so satisfactory as might have been expected. As far back as January 1871 it was ordered that cattle suffering from contagious lung disease be slaughtered; at the same time provisions were made for the complete isolation of whole districts or communes if necessary. In respect of such isolated places no imports or exports of cattle were permitted. Suspected animals were marked and inspected every fortnight by one of the district veterinary surgeons, of which there were eight appointed, besides 36 inspectors in sub-districts. During the year the number of attacks reported was 6,078.

In 1872 a Royal decree was issued for the compulsory slaughter of cattle affected with pleuro-pneumonia, while the rest of the herd was to be regarded as suspicious for a period of three months, this restriction was to be reduced to one month, provided the district veterinary surgeon declared in writing that the suspected animals had been inoculated within a period of eight days after they became suspected. During the year 4,076 cases were returned, which was 2,070 less than for the preceding year, 1871. In this year petitions were sent in from different provinces advocating inoculation of the whole of the stock in the country, but the minister declined to accede to the request in consequence of the expense, and the difficulty of obtaining inoculating matter.

In October 1873 regulations were issued for the registration, examination, and removal of cattle, and the suspension of markets and sales for the purpose of checking the disease. By this order a list of all cattle was to be made in the various districts, and any change in their number was to be made the subject of special notice by the proprietor to the district veterinary surgeon and the burgomaster. The cattle inspectors were bound to examine each herd every week and report to the burgomaster any change in their numbers, either by sale or disease. The number of attacks reported during 1873 was 2,479.

In 1874 the slaughter of diseased animals was continued. Suspected animals were inoculated and strictly isolated, while all healthy cattle were registered and inspected every week. During this year the reported attacks were 2,137.

Of the actual protective value of inoculation, the system which has been pursued in the Netherlands affords no indication, as the measure is associated with compulsory slaughter of diseased, and isolation of suspected animals. On this important point, however, some further evidence has been obtained in this country, not, however, of a sufficiently definite nature to decide the question.

In the report on pleuro-pneumonia for the year 1873, some account was given of observations on the results of inoculation with the exudate from diseased lungs, chiefly in reference to the local and constitutional effects of the operation on dairy cows in one of the large London dairies. These experiments possess a special interest, owing to the sudden appearance of pleuro-pneumonia among the inoculated animals.

In the sheds where the experiments were conducted, pleuro-pneumonia had appeared on two previous occasions.

In 1871 the disease was introduced when the stock consisted of 35 cows, of these 25 were disposed of in consequence of the disease. The 10 animals which resisted the infection, and others which were purchased, making a total of 26 cows, were inoculated; and in March 1872 all these animals were sold to the present proprietors of the dairy, who made fresh purchases to the number of 14, thus making a total number of 40 cows.

In the spring of 1872 pleuro-pneumonia appeared among these animals, and, by the 4th of June, 14 cows had been disposed of. Up to the 10th July seven more of them were attacked and sent to the butcher.

Inoculation was continued in the case of all fresh animals introduced, and no further outbreak of pleuro-pneumonia occurred until March 1874, at which date the stock consisted of 35 cows and one bull, all which had been successfully inoculated by Mr. Priestman at various periods since July 1872.

A few months before the last outbreak of disease several fresh cows were purchased in lots. These animals were inoculated as soon as they were introduced, in what was termed the hospital shed, where they were kept until they had perfectly recovered from the operation. During the time they were in the hospital shed they were carefully watched, almost daily observations being made in reference to the internal temperature, state of the milk, and also the appearance of the inoculated parts.

The first lot consisted of three cows, Nos. 64, 65, 66, which were put in the hospital shed, and inoculated on October 24, 1873. All these animals were in good health at the time of inoculation.

Lot the second consisted of six cows, Nos. 67, 68, 69, 70, 71, 72. These animals were examined before inoculation in the last week of November, and several of them gave indication of fever, the internal temperature in one case reaching 106°, the animals, however, had recently calved, and it was concluded that the increase of temperature was due to this circumstance. They were all inoculated in December 1st, and in January 6th, the internal temperature of each animal was normal. From the time of their entrance into the shed the animals were looked upon as suspicious, and Mr. Priestman entertained the opinion that they had all come from a dairy in which pleuro-pneumonia existed.

A third lot consisted of six cows, Nos. 74, 75, 76, 77, 78, 79, and a bull, No. 73. All these animals were in good health, and were inoculated on December 24th.

No more fresh animals were purchased after this, and as the recently inoculated cows had recovered from the operation, there remained no further observation to make in respect of them.

On February 11th, Mr. Priestman's attention was called to cow No. 70, one of the suspected lot. This animal had shown signs of illness a day or two previously, and on the occasion of his visit the temperature was 105°. The secretion of milk had nearly ceased, and the symptoms altogether induced him to suspect the existence of pleuro-pneumonia. However, as the disease was not clearly defined, the cow was removed from the shed, and placed under treatment, which was so far successful that she was returned to the general shed on February 25th, apparently having recovered from the attack.

On March 6th, another of the suspected lot, No. 68, was attacked with illness, and this time there was no doubt as to the nature of the disease. The cow was slaughtered on March 10th, and both lungs were found to be affected.

The next animal attacked was No. 57, a cow which had been in the shed since January 1873, about 14 months. This cow was attacked with the disease on the 20th March, and was slaughtered on the 22nd.

On 23rd March No. 74 was observed to be unwell, and was removed from the shed and placed in a loose box by herself. On 24th March she was examined and presented the following symptoms. The appetite was not much altered, and she ate soft food well, but she coughed occasionally, and the respiration was considerably accelerated; the quantity of milk had diminished since the previous day, and on microscopic examination a few large granular bodies were observed; the internal temperature was 104·6°.

On 25th March the cow appeared to have altered very much since the previous examination. She was very dull, there was frequent cough and quick breathing, the appetite was lost, and she stood with arched back unwilling to move; the internal temperature at 10 a.m. was 106·4°, and the milk was much diminished in quantity. At 5 p.m. these symptoms were aggravated, and it was evident that the cow was getting rapidly worse. The secretion of milk had almost ceased, and the internal temperature had risen to 106·6°.

The cow was slaughtered on the following morning. At this stage of the progress of the disease it was deemed advisable to examine all the remaining animals with the thermometer, with the view of isolating those which gave evidence of being infected. Accordingly the temperature of each animal was taken on 25th March. The following is the result of the examination:—

Internal temperature of the cows on 25th March.

No.		No.	
12	102°	59	101·4°
15	101·4°	63	104·2°
17	101·4°	64	101°
18	101°	65	104·4°
23	101·4°	66	101°
25	101·2°	67	101°
26	102·6°	69	101·4°
30	101·4°	71	101·6°
31	103·4°	72	101°
32	102°	74	106·6°
49	103·4°	75	101·6°
50	103°	76	101°
52	105·8°	77	101·2°
55	101·2°	79	101·4°
56	101·6°		

The bull was not examined, as it was kept in a separate shed, and had not been in contact with the other animals since the outbreak.

Several of the animals, as will be seen by reference to the table, had a temperature of 103° and above, but in some cases this increase was probably due to the approach of the time of calving.

The cow, No. 52, which had been in the shed since May 1873, and had been inoculated soon after her admission, had a temperature of 105·8°, on the previous day the temperature was 104°. No other signs of ill-health were apparent, excepting that the milk on being examined by the microscope was found to contain a number of large granular bodies, and also some pus-like corpuscles.

On 20th March the cow remained about the same in respect of her general health, the internal temperature still continued high, 105·6°.

On the 27th the temperature had fallen to 104·6°.

On the 28th the temperature had again risen to 105·6°, and there were evident symptoms of the respiratory organs being affected, the respiration had become laboured and quick, and the nostrils were dilated. The appetite was bad; and the evacuations were thin and dark coloured.

When this animal was first examined it was thought by the attendant that she was suffering from garget (inflammation of the udder), as the symptoms which indicate disease of the lungs had not presented themselves, the elevation of temperature was the only sign of disease for several days before the ordinary indications of pleuro-pneumonia became developed. The milk still continued full of granular bodies, and the pus cells were increased in number. On 28th March the cow towards night became rapidly worse, and it was determined to slaughter her. Immediately before the animal was killed the temperature was found to have risen to 106°.

On a post-mortem examination the right lung was found to be consolidated at its lower edge. There was no disease to be observed in the mammary gland.

No. 74, which indicated a temperature of 106·6° on March 25th, was undoubtedly affected with pleuro-pneumonia, and was accordingly slaughtered on the following day.

Nos. 31 and 49, which had a temperature slightly exceeding 103°, calved shortly afterwards, and remained healthy.

No. 63 was isolated, and placed under observation, having a temperature of 104·2°.

The attendant was very much surprised to hear that any suspicion was attached to this animal, as she was and had been milking remarkably well, and when her temperature was taken, she was chewing her cud and resting herself; her milk on examination showed only a few granular bodies.

This animal had been in the shed since the previous May, and was inoculated soon after her arrival, and remained in good health.

On March 26th, the cow apparently was much better, as she was eating well; her temperature had declined to 102·8°, and she was still giving about the usual quantity of milk. There were, however, several large granular bodies found on examination of the milk under the microscope.

On March 27th, the temperature remained the same, 102·8°, and there was no further signs of disease.

On March 28th, the internal temperature had risen to 103·8°, but the cow still fed well, and the quantity of milk had not diminished.

March 30th. There was a marked change in the animals appearance, the breathing was laboured, and the appetite was bad, and there were also the further symptoms of depressed head, staring eye, and cough. The temperature had risen to 105·2°, the secretion of milk was almost suppressed, and the fluid contained many granular bodies, some of large size.

March 31st. The cow became rapidly worse during the day, and it was determined to have her destroyed. A post-mortem examination proved that a large portion of the right lung was diseased.

March 31st. The second examination of the whole herd was made on the 31st March, seven days having elapsed since the first was made. The following were the results :—

No.			No.		
12	-	102·6°	59	-	101·8°
15	-	102°	63	-	105·4°
17	-	101·4°	64	-	101°
18	-	101°	65	-	105°
23	-	103·4°	66	-	101·2°
25	-	100·8°	67	-	100·8°
26	-	101·2°	69	-	102·2°
30	-	101·6°	70	-	101·2°
31	-	103·6°	72	-	101·8°
32	-	101·6°	75	-	102·2°
49	-	103·4°	76	-	101°
50	-	103·2°	77	-	101·2°
55	-	102°	79	-	101°
56	-	101·6°			

Cow No. 65, which in addition to having a temperature of 105°, had not fed well the day before, and had a relaxed state of the bowels, was noticed to be very dull, her appetite also was bad, she was therefore moved into the hospital shed; the temperature at 5 p.m. was 105°.

April 1st. The animal remained in the same state, there was no alteration in the character of her breathing, which was normal, but the appetite was bad, and the internal temperature was still 105°, there were only a few granular bodies found in the milk.

April 2nd. The animal was evidently worse, the temperature had risen to 106°; there was slight cough, and the milk had decreased in quantity; the breathing was not much altered. To-day the milk was full of granular bodies.

April 3rd. The temperature remained 106°, and all the other symptoms were increased in severity. The milk had almost ceased, and the little which was obtained were full of granular bodies and pus cells, the breathing had become more rapid, and the appetite was gone.

April 6th. The symptoms generally were as on the last examination, but the temperature had risen to 106·6°.

April 7th. The cow was condemned to be slaughtered.

April 8th. The animal was much worse, and would not eat, the breathing was very quick, temperature 106·2°. The cow was slaughtered at night, and on post examination it was discovered that there was extensive deposit in the left lung.

Cow No. 63, with a temperature of 105·4°, as indicated in the table No. 2, was observed to be ill at the same time as No. 65, on March 31st. This animal gradually became worse, and was slaughtered on April 9th. In this case the disease was confined to the right lung. From this time no further extension of the disease occurred. Fresh animals were introduced, and up to the present period all the cows in the shed have remained in perfect health.

A review of the circumstances just narrated, will show that the disease advanced among the inoculated cows with remarkable rapidity; and it may be fairly stated that the course of the malady in each case was characterised by all the indications which are ordinarily seen when uninoculated animals are attacked; whatever influence inoculation had in protecting the animals which escaped the disease, it certainly did not moderate the virulence of the affection in those which suffered.

The following tabular account will show that of the eight cows which were fatally attacked, out of a total of 35, four had been inoculated recently, and four some months previously to the introduction of the disease.

No.	Brought into the Shed.	Inoculated.	Attacked.	Temp.	Slaughtered.
68	Nov. 1873	1 Dec. 1873	6 Mar. 1874	—	10 Mar. 1874
78	Dec. „	24 „ „	15 „ „	—	18 „ „
48	Oct. 1872	Oct. 1872	15 „ „	—	18 „ „
57	Jan. 1873	Jan. 1873	20 „ „	106·2°	22 „ „
74	Dec. „	Dec. „	23 „ „	104·6°	26 „ „
52	May „	May „	23 „ „	105·2°	28 „ „
63	„ „	„ „	23 „ „	104·2°	31 „ „
65	Nov. „	Nov. „	31 „ „	105°	9 April „

Had the eight animals above referred to been by chance selected from the inoculated herd for the purpose of testing the protective value of inoculation, the fact of them all succumbing to the disease in rapid succession might have been accepted as conclusive evidence of the uselessness of the operation; but the animals formed part of a herd of thirty-five, and the escape of the majority will, by believers in inoculation, be attributed to its influence. It is of course impossible to prove that the immunity which was enjoyed by twenty-seven cows of the herd was not due to inoculation, but it is also impossible to prove the affirmative. In a previous outbreak of pleuro-pneumonia among a herd of twenty-two, Channel Island cows, in the neighbourhood of Tunbridge, the mere isolation of infected animals was followed by the cessation of the disease. On the first examination of the herd two animals were suffering from the disease. The rest of the herd were tested by the thermometer and two cows were found to have a temperature of 104°, they were immediately removed from the herd, although they showed no sign of ill health otherwise, and were placed in a field at some distance from the other stock; in a few days both of them showed distinctive symptoms of pleuro-pneumonia. Another examination of the herd was made in a fortnight, and two other cows were isolated in consequence of the temperature being above 103°, these animals also succumbed to the disease. Other examinations were made by the aid of the thermometer at different times, but no further extension of the affection took place.

Another marked instance of the good effects of the system of isolating infected animals as soon as a rise of internal temperature is detected came under the observation of Mr. Cope, the assistant inspector attached to this department; in reference to this case Mr. Cope has furnished the following particulars :—

The herd originally consisted of 33 animals. The cause of the outbreak was not ascertained. In the month of March one of the cows of a herd of 33 animals showed symptoms of illness, and towards the end of the month became so bad that she was suspected to be affected with pleuro-pneumonia, accordingly the local authority was communicated with, and on the 4th of April the animal was condemned and slaughtered under the direction of the inspector. There then remained, of thirty-two animals, fifteen steers and heifers, with fifteen cows and two calves.

A period of eight weeks elapsed before another animal showed symptoms of being diseased; on the 20th June this animal was condemned and slaughtered by order of the local authority. Another case occurred in July, and on the 16th of that month an

ENDIX.

ro-
umonia.

examination was made of the whole herd by the aid of the thermometer. The temperatures indicated by the fifteen young stock are shown in the table.

No.		No.	
1	106·2°	9	102°
2	105°	10	102·4°
3	102°	11	103·2°
4	101·8°	12	101·8°
5	101·6°	13	102°
6	102·2°	14	102·2°
7	103·4°	15	102°
8	103°		

Nos. 1 and 2 were affected with the disease in a well marked form, and they were immediately slaughtered.

Three others, No. 7, 8, and 11, indicated a rise of temperature which justified a suspicion that they were infected, accordingly, as all the young animals were in good condition, in fact nearly fat, it was determined to send them to the butcher.

The remaining animals, fourteen cows and two calves, were also examined and the temperature in each case was recorded as follows:—

No.		No.	
1	105·6°	9	102·2°
2	104°	10	102°
3	104° (calf.)	11	102·8°
4	104° (calf.)	12	102°
5	103° (near calving.)	13	101·6°
6	102·2°	14	102°
7	102°	15	102·4°
8	102°	16	104°

Nos. 1 and 2, having temperatures of 105·6° and 104° respectively, were isolated, together with the calves Nos. 3, 4, in both of which the internal temperature stood at 104°.

Beyond separating the animals Nos. 1, 2, 3, 4 from the rest of the herd, no further measures were taken until the 25th of July, nine days afterwards, when another examination was made with the thermometer, with the result indicated in the following table:—

No.			No.	
1	101·6°	isolated.	9	102°
2	105·4°		10	102°
3	104°		11	102·8°
4	104°		12	103·8°
5	103° (near calving.)		13	101·6°
6	102·4°		14	102°
7	102°		15	102°
8	102°		16	104°

Nos. 12 and 16, having a temperature above 103°, were immediately removed from the herd.

On referring to the list it will be noticed that a great reduction had taken place in the temperature of No. 1: and it was ascertained upon examination of the animal that she was suffering from inflammation of the mammary gland, which had passed into the suppurative stage; and an examination of the milk showed the presence of numerous pus cells. The general appearance of the animal was, however, good, and the appetite had increased.

It will also be observed that a great alteration had taken place in No. 2, the temperature having increased by 1·4°; the animal did not, however, show any other symptoms of disease.

The next examination of the herd was made 31st July, and the following table indicates the temperatures which were recorded:—

No.			No.	
1	101°	These animals were isolated.	9	102°
2	105·4°		10	102°
3	104°		11	102°
4	104°		12	102° isolated.
5	103°		13	101°
6	102°		14	102°
7	102°		15	102°
8	102°		16	104° isolated.

On this occasion it was evident, by the decline in the temperature of No. 1, and gradual improvement in all respects, that the unusually high temperature of 105° on 16th July was due to the affection of the mammary glands. Cow No. 2, however, had considerably changed in all respects for the worse; the breathing was affected, the milk was greatly reduced in quantity, and contained a large amount of exudative matter, and a few pus cells; this animal was therefore removed to a shed at a distance from the rest of the suspected group. In the two calves (Nos. 3, 4), as will be seen, the thermometer indicated a temperature of 104°, while in No. 12 the temperature had fallen to 102°, in No. 16 it remained at 104°. The next day, 1st August, the temperatures of the isolated animals were as follows:—

No.		No.	
1	101°	4	104°
2	105·4°	12	102°
3	104°	16	103°

On the following day, 2nd August, the thermometer indicated as follows:—

No.		No.	
1	101°	12	101°
2	105·4°	16	103°

No. 1 was still improving in health generally. In No. 2 all the evidences of pleuro-pneumonia were strongly marked, and the cow was slaughtered and buried, whilst No. 12 and 16 continued free from any indications of the disease.

On 4th August another general examination of the herd was made, and the following list shows the temperature of each animal:—

No.		No.	
3	101°	10	102°
4	101°	11	102°
5	103° near calving.	12	102°
		13	101°
6	102°	14	102°
7	103°	15	102°
8	101°	16	102°
9	101°		

The isolated animals were examined daily by aid of the thermometer and the whole herd was tested occasionally with the same instrument but up to the latter end of August no change of importance was indicated.

On the 25th of August an examination was made of the cows, which had up to the time remained healthy, whilst those animals which had been isolated had gradually recovered the normal temperatures; the result, however, proved that the disease was not yet eradicated, for No. 3., one of the calves which had been isolated at the time when the first general thermometrical examination was made, now gave evidence of being affected with disease, as will be seen from the following table:—

No.		No.	
1	101°	10	101°
3	105·4°	11	101·4°
4	102°	12	101·4°
5	102°	13	102°
6	101·6°	14	102°
7	101·4°	15	101°
8	101·6°	16	101·6°
9	101·4°		

This animal (No. 3), although having a rise in temperature, did not, in the opinion of the local inspector and the attendant, present any symptoms of pleuro-pneumonia at this date, August 25th. It was, however, placed apart from Nos. 1, 12, 16, together with the other calf, No. 4.

The time was near, within a few days, for the removal of the restrictions, and the farmer, anxious to avail himself of the opportunity to move the three cows which had now been about five weeks isolated, and doubtless believing in his own mind that they were not likely to become affected with the disease, contrary to advice, on the 30th day after

APPENDIX.

Pleuro-Pneumonia.

the last animal No. 2 was slaughtered, placed these cows along with the rest of the herd. This event occurred on the 30th of August. The same day the temperature of the calf No. 3 rose to 105·6°, on September 2nd it rose to 105·8°, when I advised the slaughter of the animal, feeling confident that it was affected with pleuro-pneumonia.

Up to this period it will be observed that of six animals out of 16 which were on the first and second visits isolated in consequence of having an internal temperature above 103°, two had succumbed to the disease, one (No. 1) had clearly been the subject of an affection of the mammary glands only, while Nos. 4, 12, and 16 had returned to a normal state, as will be seen by the following table, which was taken the day before they were mixed with the rest of the herd:—

No.			No.	
1	101°		9	101°
3	105·4°	separated with No. 4.	10	101°
			11	101·4°
4	101·2°		12	101°
5	101°		13	101°
6	101°		14	100·6°
7	101°		15	101°
8	101·4°		16	101°

Calf No. 4, remaining healthy, was sold to the butcher and slaughtered on the premises.

The return to the herd of those animals which had evidently been exposed to the contagion, i.e. Nos. 1, 12, 16, having taken place (unadvisedly), it was suggested that the herd should be divided into small lots of three or four animals, and kept apart from one another, and that they should be continually watched, and that the temperature should be taken of the whole of the animals at least once a week, but in the event of either of them giving any indication of ill health they were to be immediately isolated, as had been done previously.

Four days after having been released from the isolation shed, two of the herd were found to have an elevation of temperature, No. 16, which had already been placed in quarantine, and which had clearly been exposed to the influence of the contagion, and No. 10, which was one of the original herd, and now for the first time showed any symptoms of being affected. The annexed list will show the state of the herd on September 4th.

No.		No.	
1	101°	11	101°
5	101°	12	100°
6	100°	13	100·4°
7	101°	14	101°
8	101°	15	101°
9	100·6°	16	103·4°
10	103·8°		

These animals, Nos. 10 and 16, were therefore placed by themselves, and the following day the temperature had risen to 104·6°, on the next day No. 10 was found to be 104·6°, but No. 16, had risen to 105°. On the 7th of September the whole herd were examined, and the temperatures recorded as follows on September 7th.

No.			No.		
1	101·6°		9	101°	
2	slaughtered	diseased.	10	104·6°	isolated.
3	do.	do.	11	101°	
4	do.	healthy.	12	100·2°	
5	101°		13	101°	
6	101·8°		14	101·2°	
7	101·2°		15	101·4°	
8	100·6°		16	104°	isolated.

On the 8th notice was given to the local authority, and on the 9th, Nos. 10 and 16 were slaughtered, all the symptoms of pleuro-pneumonia being fully developed.

Since this period, September 9th, no further cases of the disease occurred.

In this instance the mere isolation of infected animals was followed by the cessation of the disease, after four of the 16 cows had been attacked; and many similar instances have been met with, as stated in the former report.

Inoculation as a preventive of pleuro-pneumonia still occupies a dubious position, in which it is likely to continue until experiments on an extensive scale have been carried out for the purpose of determining its actual protective value.

FOOT-AND-MOUTH DISEASE.

Foot-and-Mouth-Disease.

In the beginning of 1874 foot-and-mouth disease began to extend its area, and continued to increase, week by week, as rapidly as it had declined in the corresponding periods of the previous year.

The malady reappeared in the Metropolitan market in November 1873, as stated in the last report. In January 1874 between 20 and 30 diseased animals were found in the market and lairs adjoining, and in February, March, and April the cases were more numerous. On April 23rd, 89 cattle were found suffering from the disease in the market and the lairs. Towards the end of the summer the number of cases diminished. During August and September, when there were large numbers of foreign animals in the market from Tonning and Oporto, very few cases of foot-and-mouth disease were detected. In November the disease was more frequently observed, and in December the number of cases rose considerably.

All the animals which were found to be affected with foot-and-mouth disease were always slaughtered within the market area; but no precautions were taken in respect of those which had been herded with them, and it cannot be doubted that the movement of large numbers of infected animals from the Metropolitan and other markets and sales of cattle all over the country is the chief cause of the extension of the disease.

Information of the existence of foot-and-mouth complaint was received during the year from the following places in England: Rutland, Oxfordshire, Northamptonshire, Monmouthshire, Durham, Berkshire, Cambridgeshire, Isle of Ely, Cheshire, Cumberland, Westmoreland, Derbyshire, Essex, Wilts, Hants, Hunts, Kent, Lancashire, Leicestershire, Yorkshire, Warwickshire, Surrey, Dorset, Somerset, and Salop; and in Scotland, in Kincardineshire, Fife, Edinburgh, Dumbarton, Dumfries, Alloa, Inverary, and Aberdeen.

Outbreaks of foot-and-mouth disease in a severe form occurred in some parts of the country, and considerable mortality was recorded; but in the cases which were investigated the losses were more properly attributable to maltreatment than to the virulence of the disease. On the Continent the progress of foot-and-mouth disease exceeded its rate of prevalence in Great Britain, and during the year it extended to all the chief exporting countries.

In January 34 diseased animals were landed in this country from France and Oporto. In February the number of diseased animals suddenly rose to 346, all of which were from Oporto. The March returns indicated a still further increase of the malady, 405 diseased animals, 359 of which came from Oporto, and the rest from Germany, were landed at English ports. In April the number fell to 277 animals from Germany, Netherlands, France, and Belgium. In May there was a still further decrease, only 36 diseased cattle were landed from Oporto. In June, however, the number

-and-
th
ase.

rose again to 456, chiefly swine from Germany, Netherlands, Portugal, and Antwerp. In July seven diseased animals from France were landed. In August 170 animals affected with foot-and-mouth disease were landed from France. In September 15 cattle affected with foot-and-mouth disease were landed from Portugal, since which time that country has been free from disease, at least no diseased cattle have been landed at our ports. In October four animals affected with foot-and-mouth disease were landed from the Netherlands. In November Germany sent 142 animals suffering from foot-and-mouth disease, and in December the number was largely increased; no less than 725 animals suffering from foot-and-mouth disease were landed from Germany, France, and Belgium.

It will be observed that these numbers indicate only those animals in which the disease was detected on landing, and which were therefore in all probability infected when they were shipped. There is no reason to believe that foot-and-mouth disease was introduced into this country by any of the cargoes referred to, as under the present severely restrictive regulations all the animals of a cargo are slaughtered at the landing place or adjacent thereto, if a single case of foot-and-mouth complaint is found in any animal of the cargo.

In the spring of 1874 foot-and-mouth disease was reported to have caused the death of many animals in Dorset. Mr. Cope was instructed to make an inquiry, the results of which are included in the following report.

An outbreak of foot-and-mouth disease occurred in the county of Dorset during the latter end of the month of May; several animals died, it was stated, from the disease, which was of a virulent kind.

The district in which the outbreak took place was on the borders of Somerset, Wilts, and Dorset, where the farms are chiefly pasture, and where large numbers of cows are kept for dairy purposes.

The disease was introduced into this district by animals purchased in Shaftesbury market. After purchase they were driven to a piece of pasture some distance from the owner's house, and there isolated from the rest of his stock, the same men, however, who milked the home stock, were sent to milk those which had but recently arrived, consequently the disease which first appeared among the newly purchased animals, soon spread to the whole of the dairy.

Of 10 heifers purchased in Shaftesbury market two died. The disease very quickly spread to nearly the whole of the animals in the dairy, upwards of 100 in number, at a season when grass had become unusually scarce, in consequence of extreme drought. The animals necessarily required a great amount of attention; more especially was this the case in respect of this herd, for prior to their being attacked with the disease they had been kept in very low condition; the animals after becoming affected received very little attention, those which were unable to walk were supplied with a bundle of hay as they lay in the fields, and the farmer positively declined to cut his tares for those which were affected in their mouths. Under such treatment the animals soon began to sink for want of nourishment. A few days after becoming affected, several of them lay down, and were unable to rise, and remained exposed in the pastures during the course of the disease.

Eventually eight of the animals in the dairy died, from the combined effects of the disease and the improper treatment to which they had been subjected.

From this centre the affection spread, and several farms in the neighbourhood speedily became infected; notably, one next to the farm in question, upon which upwards of 50 dairy cows and several calves were kept; the whole of these animals took the disease, some were attacked with it in its worst form, several of the cows were to be seen in the fields with their tongues hanging from their mouths, and quite unable to collect food for themselves. The owner of these animals, however, devoted a great deal of his time to their treatment, and carefully attended to their comfort in every way; provided them with bran mashes, vetches, and cut grass; and in all the worst cases he fed the animals with small pieces of linseed cake.

After the more serious symptoms had passed away the cows recovered rapidly, and the owner referred to reaped the benefit of his attention by saving the whole of his herd.

Another farmer, who purchased four heifers from the infected herd on the same day at Shaftesbury market, found a few days after the animals arrived home that he had thereby introduced the disease upon his premises. The affection attacked the whole of his dairy cows, 46 in number, by degrees; but his loss was limited to one calf a few days old, which died soon after the mother had become affected.

In this instance also great attention was paid to the animals diet, and to the cleansing of the premises in which they were kept; and although about six of them became very lame as the result of the disease assuming a severe form in their feet, they lost very little flesh, and were soon found to be yielding their average quantity of milk.

The disease extended through the valley in the direction of the county of Somerset, and attacked the animals on several farms between Shaftesbury and Sherbourne, and also was found to exist on several farms in the neighbouring counties of Wilts and Dorset; but in no instance was the mortality so great in proportion to the number of animals kept as upon the farm in which the disease was first introduced in the district of Shaftesbury.

Foot-and-mouth disease existed very generally in this country during the summer months of the year; several outbreaks occurred in the north of England, and in Scotland, and the disease extended as far north as the Highlands, where several herds were reported to be affected. In the counties of Stirling, Dumbarton, Renfrew, and Lanark the malady was very prevalent, particularly in the neighbourhood of Stirling, during the month of June. In most instances which were investigated by Mr. Cope, the disease was traced to animals, the property of cattle dealers or butchers, this was the case in a severe outbreak which occurred in the district of Stirling.

In the latter part of the year Mr. Cope made inquiries respecting an extensive outbreak of foot-and-mouth disease which occurred in the neighbourhood of Cuckfield. It was found that on many farms the animals were suffering from the disease, which, in nearly every instance, had been introduced by animals which had been recently purchased at Horsham and East Grinstead fairs.

Foot-and-mouth disease had existed to a very slight extent in Sussex during the whole of the summer; but immediately after the November fair held at Horsham on the 17th of the month, notice was given of its appearance, and within three weeks the disease was reported on 15 farms.

In reference to legislation for the purpose of preventing the spread of foot-and-mouth disease, there is nothing new to be written. Doubtless the affection may be controlled by the adoption of sanitary measures on the farms where the disease exists. Isolation of diseased animals, and the imposition of restrictions on the movement of those which have been herded with them, until the period of incubation has passed, are among the most obvious preventive measures easily carried into effect by the owners of the animals, but attended with considerable difficulty, when they are enforced by local authorities against the will of the owners, who may readily evade the restrictions if they choose to run the very slight risk of detection.

SHEEP-SCAB.

Sheep-Scab.

The number of cases of sheep-scab reported during 1874 exceeded by several thousands the number returned in the previous year. Presuming that this increase in the number of cases returned really represents an increase in the spread of the disease, it could only have arisen from neglect of the precautions which are perfectly well understood by all the flock masters in the Kingdom. It was stated in the last report that sheep-scab is a disease which may readily be kept in check by the use of ordinary remedies. The local authorities have powers to compel owners of diseased sheep to apply such remedies whenever the disease is known to exist in the flock.

GLANDERS AND FARCY.

Glanders and Farcy.

From the returns of the various horse slaughterers who are licensed to receive carcases of glandered horses in the Metropolis, and from the reports which have been received from veterinary surgeons in different parts of the country, it appears that glanders and farcy existed in 1874 to a greater extent than during the three previous years. For the last two years a considerable increase has been observed in the number of glandered horses which have been sent to the horse slaughterers; this fact, however, does not necessarily imply any great increase in the number of attacks. On the contrary, it may be due to the circumstance that horse owners are becoming more impressed with the necessity for getting rid of horses affected with glanders as quickly as possible, instead of keeping them for night work as the custom was some years ago.

It does not appear that the disease has assumed a character which renders further legislation necessary. A serious attempt to stamp out the affection would be attended with great expense. And, as a rule, owners of horses are anxious to discover the existence of the disease in their own interest, and the instances in which any objections are offered to the slaughter of diseased horses have been very few. In the cases which have been investigated by the officers of this department, the owners of glandered horses have always expressed their willingness to have the animal destroyed; but have been unable to comply with the order to bury the carcase, in consequence of the difficulty of getting ground for the purpose.

At present local authorities may obtain powers to prohibit or regulate the movement out of any premises of horses which are suffering from the disease or have been affected with it, as well as those which have been in the same premises with horses so affected. It can hardly be questioned that these powers are sufficiently stringent to enable local authorities to deal effectually with the disease in localities where its exceptional virulence may render such measures necessary.

G. T. BROWN,
Chief Inspector.

PENDIX.

gary.
lations
hecking
le
ue.

Translation of Regulations issued by the Hungarian Minister of Commerce to the different Authorities with the view of checking the spread of Cattle Plague.

Buda-Pesth, March 29th, 1874.

In order that, now at the approach of spring, at which season the movement of cattle becomes more frequent, due attention may be paid to precautionary measures, as a means of preventing the return of the epizootic among animals, I invite the authorities having jurisdiction to publish the present instructions, and to prescribe to their subordinate agents to carry them out conscientiously and energetically, and not to omit to control their punctual execution.

1°. All cattle and horses must be scrupulously examined in their winter quarters, and every suspicious case at once communicated to the authorities.

2°. It is strictly forbidden to send cattle to the public pastures to be herded, unless they have first been examined and taken account of by the communal authority. Cattle not thus accounted for must not go to the public pastures. Offenders against this regulation will be punished with a fine of from 10 to 20 florins, and a corresponding term of imprisonment.

3°. In cattle fairs the existing regulations must be rigorously observed.

4°. Herdsmen are forbidden to receive into their herds cattle not recorded in the commune.

Cases of disease which occur in a herd entrusted to their care must immediately be reported (the diseased animal being at the same time separated from the rest) either to the owners or to the communal authorities; and this under pain of severe punishment in case of neglect. And in regard to this duty the communal herdsman ought to be made to make oath.

5°. In places where the cattle plague was found last year, although the dead animals may have been buried with every precaution, the pits should be inspected, and where necessary covered again and heaped over.

6°. For the losses occasioned by the insufficient publication of these orders, the respective agents of the authorities will be responsible; and for those occasioned by their non-observance, the respective communal authorities will be held responsible.

Contemporaneously with the widest possible publication of this ordinance, the public must also be informed that all cattle owners who resist the execution of the prescribed rules, or who endeavour to escape their application, will not only be held responsible, and made to pay damages for losses caused by their conduct, but, in proportion to the gravity of the offence, will be punished by a fine of from 100 to 500 florins.

The last outbreak of the cattle plague has been stamped out so successfully that the authorities are not aware that there is at this moment in the whole of Hungary a single diseased beast. But as the utmost precaution must be taken to render innocuous the most trifling case of cattle plague, I request the authorities to issue orders to their different inspectors on the railways within their district to the effect that railway trucks intended for cattle transport be properly disinfected at the stations appointed for the purpose; and to assure themselves of the execution of this measure by strict examination, reporting immediately to me any case in which neglect has been proved, in order that steps may at once be taken to remedy it. All railway managements in the kingdom have received notice in this sense.

For expenses incurred on this account, for returns, journeys, &c., a report must be daily made to me for my approval.

A further report, containing an account of all the steps taken in execution of these orders, and also of the manner, energetic or otherwise, in which they have been carried out by the authorities and their subordinates—containing further such observations as may result from the application of the rules in different districts—shall without fail be made to me at the end of the next ensuing month of April.

Lastly, while requesting the co-operation of the authorities under my jurisdiction in the punctual execution of this important order, intended to protect those interests of the kingdoms of which we must never lose sight, I am happy to express my conviction, founded on the experience of the service of last year in regard of the sanitary measures taken for cattle, that the remarkable energy and zeal of the authorities is a sufficient guarantee that they will, with their usual devotion to the public service, hasten to assist in preserving the interests of the country in this respect, thus crowning the edifice of their deserts in this branch of the administration.

(Signed) Bartal.

---

gary.
relating
attle
gue.

Translation of an Act passed in 1874 by the Hungarian Diet relating to Cattle Plague.

Act XX. of the Year 1874, being Statutes concerning Measures against Oriental Cattle Plague.

Sanctioned 13th June 1874. Published in the Lower House 22nd July 1874, and in the Upper House 24th July 1874.

Article I.

MEASURES UPON THE FRONTIERS.

A.—Measures in regard to such States as carry out a system of which the fundamental principles are in accord with this Act.

§ 1.

Horned cattle and other ruminants must only (with the exception of such as come by steamer or rail) be brought into the country at certain places of entry, which have been decided upon beforehand by the frontier authorities concerned.

§ 2.

From such countries as have measures in operation of which the fundamental principles are in accord with this Act, and exercise them rigidly, the said animals can be freely imported so long as the country concerned is free from cattle plague, upon condition that they be provided with cattle passes and certificates of health.

§ 3.

Supervision of the Frontiers.

When in the territory of such a country oriental cattle plague has broken out, but at first remains limited to any spot over five* miles distant from the frontier, the supervision of the threatened frontier district must be effected.

Throughout the duration of the frontier watching—

(*a.*) Horned cattle and other ruminating animals, whether living or dead;

(*b.*) All raw materials which may be reckoned as belonging to these animals, whether in a fresh or dry condition;

(*c.*) Hay, straw, and all other necessary fodder of every kind;

(*d.*) Utensils and appliances used in the stalls, clothes and drapery which has been worn;

---

* The Austrian mile = 4·71 English miles.

APPENDIX.

Hungary. Act relating to Cattle Plague.

Must only be brought from the country in question, by either ordinary routes of entry, or, if necessary, at certain limited points, provided

1. That it be authoritively proved that the animals or materials proceed from a neighbourhood free from cattle plague, and have been forwarded by a route also free from cattle plague; and
2. That the health of the animals be proved to be beyond suspicion, by the production of prescribed certificates of health, and by examination of the animals at the frontier by experts.

§ 4.

Frontier Blockade.

Should cattle plague attain greater dimensions in a neighbouring country, or should it seriously approach the frontier, the frontier tract along the endangered country or neighbourhood is to be entirely blockaded.

Throughout the duration of the blockade, all animals and materials mentioned in § 3, *a.*, *b.*, *c.*, and *d.*, are to be sent back, with those exceptions mentioned in §§ 5 and 6.

But such persons as come into contact with the said animals and materials may be allowed to enter the country after thorough disinfection.

§ 5.

Transports of animals for slaughter from the territory of a neighbouring country free from cattle plague are exceptionally permitted with due observance of the arrangements of § 3 during the frontier blockade, under the following conditions:—

(*a.*) In every individual case of import a special license must be obtained from the Minister.

(*b.*) The transport may only be effected by means of railways or ships, and that by a direct route to the place of destination.

(*c.*) With consignments sent for transit, it must be authenticated that the Government of the neighbouring country into whose territory the consignment will next enter has permitted that this import should be effected.

§ 6.

And farther, while the frontier blockade lasts there may be imported—

(*a.*) Wool cleansed at a wool cleansing factory and properly packed in sacks, intestines salted or dried in closed cases or casks, melted tallow, and cheese, without any limitations.

(*b.*) Wool, cow and goat hair, not cleansed for manufacturing purposes, but properly packed in sacks dry bones, horns, and hoofs, and thoroughly dry skins, if their origin be proved, in the sense of § 3, to be from a quarter of the neighbouring country which is free from disease.

(*c.*) Unwashed wool, cow and goat hair, properly packed in sacks, may only be imported if they be delivered dried to the washing department of a manufacturing establishment, and provided that this can be done without danger under prescribed regulations.

(*d.*) Casks and cases containing goods packed in straw may be imported, but all the hay or straw which has been used for the purpose must be immediately burned after unpacking under official inspection.

§ 7.

The cases recited in §§ 5 and 6 serve as a rule, that—

(*a.*) Any loading *en route* of animals for slaughter may only take place through the urgent necessities of the railway traffic, in entirely isolated places.

(*b.*) The consignment of animals on arrival at any destination is to immediately undergo inspection by the local Veterinary Sanitary Commission of Inspection, and after verifying the health of the animals they are to be sent on to the place assigned for cattle.

(*c.*) Should the cattle plague break out on the way, or on arrival at their destination, all the consignment is to be slaughtered according to the conditions laid down in § 54.

If upon examination one single piece of skin, bone, or horn be found among a consignment sent for entry, in a fresh condition, the entire consignment is to be sent back.

§ 8.

So soon as the disease breaks out at a less distance than five miles from the frontier, the "infected district" sections of this Act (§§ 41, 42, and 43) are to be brought into operation.

B.—MEASURES IN REGARD TO SUCH STATES AS DO NOT CARRY OUT A SYSTEM OF WHICH THE FUNDAMENTAL PRINCIPLES ARE IN ACCORD WITH THIS ACT.

§ 9.

Permanent Frontier Watching.

Towards such countries as do not carry out a system of which the fundamental principles are in accord with this Act against cattle plague, or who do not exercise it stringently, there must be permanent armed watching of the frontiers.

§ 10.

On the frontiers of these countries, the trade in ruminating animals specified in § 3, animal raw material and other contagious matters is only permitted at quarantine stations established at certain defined import places.

The determination of the import places in regard to the dimensions of the traffic and the local requirements, as well as establishing quarantine stations, and the compilation of instructions concerning quarantine stations, as based upon this Act, is in the province of the Minister.

§ 11.

Should the entire territory specified in § 9 be free from cattle plague, or should the disease be limited to a few small places more than eight miles distant from the frontier of the Hungarian States, the trade in horned cattle and other ruminating animals is permitted under the following precautionary conditions:—

(*a.*) That all cattle admitted past the frontier should be kept in separate droves in the quarantine stations for 10 successive days (in the case of sheep and goats 24 hours) under strict veterinary supervision.

(*b.*) Those animals which after undergoing the prescribed quarantine are proved to be non-suspicious, are, upon being furnished with ordinary frontier cattle passes and certificates of health, to be watched for at least five miles on the ordinary highway or to the next railway or shipping station, and to be then inspected by the veterinary surgeons sent out for this purpose.

(*c.*) In forwarding by means of railways or ships the measures are to be applied which are contained in § 7.

(*d.*) Should cattle plague break out among the cattle in a quarantine station, all the cattle forming this suspected drove are to be slaughtered and no claim allowed for compensation. As concerns the remaining animals in the quarantine station at the time, the quarantine period may be extended according to circumstances.

§ 12.

Under the circumstances recited in § 11, raw stuff originating with ruminating animals, and other

ENDIX.
gary.
elating
ttle
ue.

materials subject to contagion may be imported as follows :—

(*a.*) Wool cleansed at a wool cleansing factory and properly packed in sacks, intestines salted or dried in closed cases or casks, melted tallow, and cheese, without any limitation.

(*b.*) Wool, cow and goat hair, not cleansed for manufacturing purposes, but properly packed in sacks, dry bones, horns and hoofs, and thoroughly dry skins after a prescribed disinfection; but if on the contrary—

(*c.*) These animal substances which do not possess the qualities enumerated under points (*a.*) and (*b.*), or upon examination any one piece being found to be in a fresh condition, then the entire consignment is to be sent back.

(*d.*) Respecting unwashed wool, as well as hay and straw used for packing, the measures are applicable, recited under points (*c.*) and (*d.*) of § 6.

§ 13.

Should cattle plague assume larger proportions in any of the countries specified under § 9, or should it appear at a less distance than eight miles from the Hungarian State frontier, then in place of the ordinary frontier watching opposite the infected countries there must be effected a most stringent frontier blockade.

Throughout the duration of the stringent frontier blockade, all ruminating animals, all articles of raw material originating with them, stall utensils and appliances, clothes in wear, and drapery are to be unconditionally rejected. The exception to this rule is wool washed for manufacture and properly packed in sacks, dried or salted intestines packed in close cases or casks, melted tallow, and cheese, as well as hay and straw used in packing, provided this last be immediately burned after unpacking, under official supervision.

§ 14.

Frontier Cattle Register.

In that portion of the country extending five miles inwards from the frontier under constant watching there shall be established a cattle conscription, and in all frontier communes falling within this extent regular cattle registers will be kept according to instructions issued by the Minister. For this purpose every cattle owner is bound to give in a list of all the cattle in his possession, or born subsequently therein, and to report every fresh purchase for inscription, and to have marked off all cattle sent to the market, and also those actually sold. The various cattle of all these communes are to be distinguished by an ordinary communal brand.

§ 15.

For the purpose of keeping these registers according to the foregoing section, and to watch over the strict fulfilment of its provisions, farther to have a competent staff of supervising agents to supervise the quarantine operations on the frontiers, and, lastly, to watch over and ensure the execution of the various arrangements contained in this Act, State veterinary surgeons will be detailed according to the measure of requirements.

C.—ARRANGEMENTS ALONG THE SEA COAST.

§ 16.

In respect to the system to be pursued in regard to quarantine stations along the sea coast, the measures prescribed in §§ 11, 13, will serve as a rule in dealing with ruminating animals and animal raw products sent by sea, with the exception that salted skins arriving by sea may be imported without disinfection.

The special arrangements in regard to sea quarantine stations are contained in the coast sanitary police measures.

ARTICLE II.

PERMANENT ARRANGEMENTS IN THE INTERIOR OF THE COUNTRY.

§ 17.

Cattle Certificates.

Upon the sale or removal of ruminating animals of all kinds (cattle, sheep, and goats), in addition to a cattle pass showing the ownership, a certificate of health is required as a verification of the animal's healthy condition.

The certificates of health are issued by the local authority at the time of prevalence of cattle plague, both in the territory affected with it, and in the adjacent jurisdictions, and are to be founded alone on a medical, or, where possible, a veterinary examination, and are to be medically countersigned. Both cattle passes and certificates of health can be issued either for individual animals or for an entire drove.

The certificate of health must always refer to some specified spot, and is available for seven days from its date of issue. In what cases any exceptions may be permitted to the regulations of this section, in cases of yoke cattle performing agricultural labours or going to pastures and watering places, will be prescribed by an order issued by the Minister, based upon this Act.

§ 18.

In the case of any animal provided with a certificate of health specifying a place of sale, not being sold there, but being, for the purposes of sale, removed to some other place, it will be the duty of the market commissioners during market hours, and the duty of the local authority out of market hours, to *visé* the certificates of health for another seven days for said other place, and so prolong it; but in the presence of cattle plague upon the territory of the jurisdiction specified in § 17 this can only be done under a medical or veterinary countersign.

§ 19.

Cattle Markets.

In every market-place there is, as far as practicable, to be an isolated place for foreign (not native) cattle, and any direct intermingling of foreign with native cattle is to be avoided.

In those markets where cattle are present in greatest numbers (for purposes of international trade), cattle for slaughter are to be separated from cattle for domestic and agricultural purposes.

§ 20.

No cattle are under any circumstances to be admitted to the market unless provided with cattle passes and certificates of health.

§ 21.

Those charged with holding cattle markets are bound to secure the services of either a certificated veterinary or other surgeon, for the duties connected with the exercise of veterinary sanitary police supervision, on every market being held.

§ 22.

Slaughterers.

All slaughterers are bound to give notice within 12 hours of the purchase and presence of any animal not belonging to the communal authorities.

It will be optional for the communal authorities to assign an isolated meadow for the use of the cattle belonging to the slaughterers.

§ 23.

In case of the prevalence of disease, the slaughterers living in the jurisdictions both within and adjoining the infected part are to keep all animals isolated and away from other cattle which have been purchased within 10 days and are not yet slaughtered. After the lapse of 10 days those animals found to be healthy can be mixed by the slaughterers with their other

Hungary. Act relating to Cattle Plague.

cattle, but are to be kept separate from cattle belonging to the commune, either in stalls or meadows.

§ 24.

When in the territory of a province, or in an adjacent jurisdiction, the cattle plague prevails, the Central Disease Commission can forbid the slaughterers to enter into strange stalls, or to come in contact with the animals in the pastures.

§ 25.

The slaughtering-houses shall be outside the commune so far as practicable, and distant from the main thoroughfares, for the purpose of preventing the contact of the animals for slaughter with draught and domestic cattle, as well as with other ruminating animals.

Animals for slaughter must be slaughtered in the slaughter-houses alone, and in the presence of the slaughter commissary.

§ 26.

Shepherds.

It is forbidden to shepherds to receive cattle in the communal herds without permission of the local authority.

§ 27.

Houses of Entertainment.

During the prevalence of cattle plague no strange healthy cattle may be brought to inns, &c., unless they are kept from all contact with other ruminating domestic animals.

§ 28.

Common Meadows.

Before horned cattle are turned out into the meadows after wintering in the stalls, their healthy condition must be examined into, and they must be enumerated. Cattle not accepted by the local authority must not be driven into the other herds.

§ 29.

Cattle Driving and Conveying.

Persons connected with the trade in cattle for slaughter and other purposes, may forward their cattle only by means of rail or water, or by certain roads assigned for this purpose by the jurisdiction.

Of course it is understood that by this measure forwarding cattle by road is not limited to taking them to the owner's establishment or to pasturing places.

§ 30.

Transit by means of Railway and Shipping.

In the forwarding of horned cattle and other ruminating animals by railway or shipping the following rules are to be observed:—

(*a.*) Horned cattle and other ruminating animals may only be taken upon production of the prescribed cattle passes and certificates of health.

(*b.*) The animals to be forwarded may only be taken up for that spot, or for the next railway or shipping station to that spot, for which the cattle pass is valid.

(*c.*) Upon both loading and unloading, the consignments are to be examined by the Veterinary Commission of Inspection.

(*d.*) It is forbidden to transport cattle for slaughter with draught or domestic cattle.

(*e.*) In the case of § 5 it is forbidden to drive any animal from a foreign country with a native animal, that is, in the same yoke.

(*f.*) The railway trucks, ships, and gangways are to undergo a prescribed purification after each transport.

(*g.*) The directors of railway and shipping companies, who will be entitled to payment of dues for the disinfection and purification as approved by the Ministry, are responsible for the strict execution of this measure.

ARTICLE III.

REGULATIONS UPON THE APPEARANCE OF DISEASE AND IN CASE OF THE OUTBREAK OF CATTLE PLAGUE.

§ 31.

Declarations.

Everyone is bound to give immediate notice to the local authority of the existence of any perceptible internal disease of any kind whatever, either among his own cattle or among any that may be in his care. This duty is especially imposed upon those who by virtue of their calling can quickly and positively recognise disease, as veterinary surgeons, members of the veterinary police commission, farm bailiffs, shepherds, slaughterers, cattle dealers, and other individuals of similar occupations.

§ 32.

Duties of the Local Authorities.

When signs of oriental cattle plague are perceived upon an immediate examination of any animal with appearances of disease, or if a case of cattle plague be only suspected, the local authority is bound to place the competent higher authority in knowledge of the fact, and until the delegates from the high authority arrive upon the spot—

(*a.*) To strictly isolate the suspected farm or place.

(*b.*) To check off the number of cattle, sheep, and goats belonging to the commune.

(*c.*) To prevent the contact of the cattle, sheep, and goats belonging to the commune with one another, and to hinder their circulation, and, where local conditions will permit it, to order all the animals belonging to the commune to be kept in their stalls.

(*d.*) To announce all suspicious incidents both in their own and in the neighbouring communes, to invite the people's attention to the infectious nature of the disease, and to exact the most stringent execution of the measures prescribed.

Any cattle which may have died meanwhile are to be removed from the suspected place, with observance of the existing regulations, to a prescribed spot, but are not to be buried before examination.

§ 33.

Duties of District and State Authorities.

The competent officials of the district or State police authorities are bound under a strict responsibility, so soon as they become aware of the suspected case—

To proceed forthwith to the spot, or in case of being prevented to send a representative.

To verify the diagnosis of the disease by the killing and examination of a diseased animal by a surgeon living on the spot or in its immediate neighbourhood, and when possible in concert with a veterinary surgeon, and to give a report of the result to the jurisdiction.

If by the appearances discovered a case of oriental cattle plague is ascertained, or a well-grounded suspicion exists of its presence, then the administrative authorities concerned are bound—

To isolate not only the farm and all farms in its vicinity, but also the commune of the adjacent estates.

To examine the cattle of the commune, and to have a list of them prepared should this not have been already done, in which case it is to be checked and verified.

To announce what further measures have been ordered in regard to those communes affected with cattle plague, and to watch over their execution.

To institute a searching inquiry as to the whence and how the disease was introduced, and to draw up a report of the result thereof.

Lastly, up to the arrival on the spot of the commission referred to in § 34, to do everything that may appear necessary or calculated to prevent the further spread of the disease.

§ 34.

Duties of the Jurisdictions.

The first jurisdiction official, so soon as he becomes aware of a presumed case of oriental cattle plague, is to forthwith send an administrative authority, the official veterinary surgeon and town physician of the jurisdictional commission, to the spot.

This commission (in the presence of the district authority) has to positively verify the diagnosis of the disease (when necessary) afresh by killing one or two diseased animals.

To consider the regulations contained in § 33, and should they be insufficient to enlarge their scope.

To establish a Communal Disease Commission where this may be necessary, and finally to draw up a circumstantial report of their proceedings, and render it to the first official of the said jurisdiction.

§ 35.

The first jurisdiction official, so soon as he is informed of the prescribed verification of a case of cattle plague, is to do everything requisite to effect isolation of the infected territory in accordance with the local requirements, either alone or in concert with the first official of the adjoining jurisdiction, and to send information, first to the Minister, then to the interior authorities, and, lastly, to any adjacent foreign authorities, by telegraph, so far as this may be practicable.

§ 36.

Disease Commission.

So soon as an outbreak of cattle plague in the country is officially announced, then the first official, or his representative, of each jurisdiction of the country, is to form a Central Disease Commission of the members thereof.

§ 37.

Members of the Central Disease Commission are—the first jurisdiction officer, or his representative as secretary, the jurisdiction physicians, and official veterinary surgeon; lastly, two extra members. No one may excuse himself from the duty without good and sufficient cause.

§ 38.

The secretary, upon receiving official notice of an outbreak of cattle plague within the territory of the jurisdiction, must convoke the commission without delay, and at longest within three days.

The Central Disease Commission, for so long as the cattle plague is not extinct on the territory of the jurisdiction, must hold an ordinary sitting at least once a week. In urgent cases the secretary can convoke it at any time, and can himself, when circumstances require it, make his own regulations, of which he should make a report at the next sitting of the Commission.

§ 39.

It is within the duties of the Central Disease Commission to carry into effect the preventive and extinctive measures contained in such orders as may be issued, founded upon this Act, by supervising their due execution.

The Central Disease Commission is in direct relationship with the Minister in its operations, and will receive his instructions direct.

The various administrative organs of the jurisdiction are bound to unreservedly carry into effect the orders and regulations of the Central Disease Commission within the province of their administration of this Act, and the Orders in connection therewith, under a stringent personal responsibility.

§ 40.

Government Commissioners.

Should the disease attain serious dimensions in many jurisdictions or in the entire country, the Ministry, so as to ensure uniform execution of the necessary measures, or to secure the strict execution of the orders based upon this Act, may send their own Disease Commissioner.

§ 41.

Infected Districts.

The environs of one or more infected commune form an infected district to an extent of three miles in every direction.

The decision as to the allowing a partial modification of this rule is in each case in the discretion of the Minister, to whom the Central Disease Commission must make the proposition.

The names of all communes and villages which fall within the infected district are to be made known without delay in all the communes of the jurisdiction, especially in those bordering on the infected district, and their names must also be announced to the Minister.

§ 42.

As the communes and villages belonging to the infected district are considered as suspected of infection from a veterinary sanitary police point of view, the precautionary measures contained in § 32 *b* and *c* are to be carried into effect therein.

§ 43.

During isolation the circulation of waggons with yoked oxen is forbidden within the range of the infected district or therefrom; likewise the driving of loose cattle, sheep, and goats from one meadow to another or out of the infected district. During this time no markets nor shows of cattle, sheep, and goats may be held, nor may any of the products of ruminating animals be brought to the market.

In special cases the holding of markets may be interdicted throughout the entire territory of the jurisdiction concerned, and in any case can only be held in virtue of a permission issued by the Ministry at the instance of the Central Disease Commission.

§ 44.

Killing the Animals by Clubbing.

The killing of the diseased and suspected animals by clubbing is to be applied where and in such a manner that its operation promises to prevent the farther spread of the disease.

The animals killed by clubbing are to be destroyed according to the prescribed regulations; the flesh and other portions of those animals found to be healthy after slaughter may be utilized in such cases and in such manner as shall upon its being effected be exempt from any possibility of spreading the disease.

§ 45.

Extinction of the Disease.

The regulations of §§ 36, 37, and 39 only cease to have force when it is officially announced that the disease is extinct in the country.

§ 46.

The disease is declared extinct—

(*a.*) When a period of 21 days has elapsed since the last animal has died, been killed, or recovered, and in no commune, district, or country has any fresh case occurred;

(*b.*) When the disinfection of the infected farms has been effected as prescribed; and

(*c.*) When in any infected place or district the health of the cattle is placed beyond doubt by a final examination.

§ 47.

The isolation of endangered farms and communes, where the animals are to be removed to which have died, and how they are to be disposed of, the killing of diseased and suspected animals, the isolation, watching, and possible killing and disposal of the others, and the isolation of other domestic animals, regulating the curative measures attempted with diseased animals, the manner in which raw products of ruminating animals are to be removed by railway or sea at the time of the prevalence of cattle plague, and all measures for purification, will be determined by the Minister in an Order issued in accordance with the principles of this Act.

ARTICLE IV.

DISTRIBUTION OF THE EXPENSES, AND COMPENSATION.

§ 48.

Distribution of the Expenses.

Those expenses involved in either temporary or permanent isolation, as well as the dues payable for military assistance in extraordinary cases for effecting the isolation of districts or communes, also for the entertainment and travelling expenses of the Commission, veterinary surgeon, and surgeon, are to be met by the Imperial Treasury.

§ 49.

The ordinary expenses attached to isolating single districts or communes are to be equally divided between the communes of the infected district and the State.

§ 50.

Any expenses incurred in the execution of preventive and repressive measures in any village or place within the district, as, isolating the diseased animals, removing and burying the dead animals, are to be borne by the commune in question or the owners or farmers concerned.

§ 51.

The cost of disinfecting individual farms or places must be borne by the farmer or owner.

§ 52.

Compensation.

For such cattle as are killed to verify the presence of the disease according to §§ 33 and 34 of this Act, or by order of the Central Disease Commission, or by order of the Government Commission in virtue of § 44, the owner will receive compensation, provided that—

(*a.*) The owner shall have given immediate notice of the animal's illness.

(*b.*) The damage shall not have been caused by the violation of any one of the regulations of this Act either by himself or by his people.

§ 53.

The compensation for healthy animals will be paid in full, always allowing for the value of the parts still available; for diseased animals half the value only will be paid.

§ 54.

For such animals as have been killed within 10 days of their entry into the country (§ 7) the compensation due according to § 52 will only be paid in those instances where it is proved that the attack occurred within the country.

§ 55.

Upon the question as to according or withholding compensation for those things destroyed for the purpose of extinguishing the disease by being susceptible to transmit infection, each case will be decided by the Central Disease Commission upon request of the interested parties.

§ 56.

Valuation.

The amount of damage sustained by the killing of animals or destruction of various objects will be determined by a prescribed valuation.

The principle of the valuation will be the absolute value of the animal without regard to the measures put in force since the outbreak of cattle plague and in consequence thereof, and will be reckoned by the earlier local prices.

§ 57.

The amount of such compensation so ascertained will be paid from the State Treasury within the shortest possible time after the receipt of the report of the Central Disease Commission.

ARTICLE V.

RESPONSIBILITY AND PUNISHMENTS FOR OFFENCES.

§ 58.

Whoever purposely violates this Act or the Orders issued in connection therewith, or assists others in so doing, is responsible for all damages occasioned thereby.

§ 59.

The owner of any cattle, sheep, or goats exposed for sale, or bought or led away without a legal certificate, shall be punished by a fine for each animal, not exceeding 100 florins.

Any cattle, sheep, or goats exposed for sale with false certificates, or bought or led away with certificates knowingly false;

Cattle not entered in the cattle register, and the owner of which cannot show any credible ground for neglecting to have them registered;

Cattle led away or smuggled from quarantine, or from the local isolation or through the frontier blockade, by the use of forbidden land or water-ways;

Shall be confiscated, without this superseding any criminal prosecution.

In case of realizing the value, if it can be effected on the spot, the proceeds are to go to the Imperial State Treasury.

§ 60.

Wilful offenders against this present Act or against the Orders issued in connection therewith, beyond being liable to pay compensation for all damages and to have the animals confiscated in all cases, are also responsible for payment of all expenses occasioned by their violation of the law or negligence in observing it, and a fine, according to circumstances, not exceeding 500 florins, which last is payable to the State Treasury; in case of inability to pay, then they shall suffer a corresponding period of imprisonment.

In case of any danger being apprehended of the offender's flight, he may be detained by the police authorities.

§ 61.

Offenders against this Act or those Orders issued in connection therewith, in so far as their conduct does not form the ground for a prosecution according to the penal code, can be dealt with by ordinary proceedings in an administrative way.

§ 62.

The authorities and police machinery detailed for the execution of these Orders, the extra members, dignitaries, and officials of the jurisdiction and communal representatives, are responsible for the due execution of this Act and of the Orders issued in connection therewith, and for all damages occasioned by their negligence, carelessness, or thoughtlessness, the last named in virtue of the Act XLII. of the year 1870 and XVIII. of the year 1871.

§ 63.

All complaints calling for punishment according to this Act, and all claims for compensation, are to be decided by the Imperial judges.

§ 64.

The Minister for Agriculture, Industry, and Trade is charged with the execution of this Act.

APPENDIX.

Diseases amongst Animals in Foreign Countries, 1874.

Foreign Countries

IN WHICH

Contagious or Infectious Diseases amongst Animals were reported to have existed during the year 1874.

CATTLE PLAGUE.

Cattle Plague was reported to have occurred in the following places :—

AUSTRIA—HUNGARY.

BUKOWINA :—
Czernowitz.

CARNIOLA :—
Gottschee.
Gurkfeld.
Loitsch.
Planina.
Rudolfswerth.
Tschernembl.

COAST LANDS :—
Capo d'Istria.
Castelnuovo.
Pisino.
Pola.
Trieste.
Volosca.

CROATIA AND SCLAVONIA :—
Agram.
Banat.
Belovar.
Fiume.
Gradiska.
Kreutz.
Lika Ottocsan.
Ogulin.
Posega.
Sluin.
Warasdin.

DALMATIA :—
Bencovac.
Macarska.
Zara.

GALICIA :—
Borszczow.
Brody.
Brzezany.
Buczacz.

GALICIA—*cont.*
Husyatyn.
Kalusz.
Kamionka.
Podhayce.
Przemystany.
Rawa.
Rohatyn.
Skalat.
Stanislawow.
Tarnopol.
Tlumacz.
Trembowla.
Zaleszczyki
Zbaraz.

HUNGARY :—
Papa.
Szorinyi.
Zala.

LOWER AUSTRIA :—
Baden.
Bruck, on the Leitha.
Mistelbach.
Sechshaus.
Vienna.
Wiener Neustadt.

MILITARY FRONTIER :—
Various districts.

STYRIA :—
Cilli.
Marburg.
Pettau.

UPPER AUSTRIA :—
Kirchdorf.
Linz.
Rohrbach.
Steyer.
Wels.

GREECE.

The island of Andros.
" Corfu.
" Jos.
" Naxos.

ITALY.

Brindisi. Capitanata.

RUSSIA.

BALTIC PROVINCES :—
Courland.
Livonia.
St. Petersburg.

EAST RUSSIA :—
Astrakhan.
Kasan.
Penza.
Saratov.
Simbirsk.
Viatka.

GREAT RUSSIA :—
Jaroslav.
Kalouga.
Koursk.
Moscow.
Orel.
Pskov.
Tambov.
Twer.

LITTLE RUSSIA :—
Kharkov.
Kief.
Pultava.

POLAND :—
Kielce.
Lublin.
Petrikau.
Plock.
Plotz.
Siedletz.
Suwalki.
Warsaw.

SIBERIA :—
Tobolsk.

SOUTH RUSSIA :—
Bessarabia.
Don Cossacks.
Ikaterinoslav.
Kherson.
Taurida.

WEST RUSSIA :—
Grodno.
Kowno.
Minsk.
Mohilev.
Volhynia.
Witebsk.

TURKEY.

ALBANIA.

BOSNIA.

BULGARIA :—
Sulina.

MACEDONIA :—
Drama.
Veria.

ROUMANIA :—
Bolgrad.
Botosani.
Cahul.
Dorohoin.
Falcin.

ROUMANIA—*cont.*
Jassy.
Vastin.

ROUMELIA :—
Burgas.
Salonica.

SILIVRIA.

SIVAS.

TREBIZOND :—
Kerasond.
Surmench.

YEMEN.

AFRICA.

Abyssinia.

APPENDIX.

Diseases amongst Animals in Foreign Countries, 1874.

PLEURO-PNEUMONIA.

Pleuro-pneumonia was reported to have occurred in the following places :—

AFRICA.

EGYPT :—
Alexandria.
Cairo.
The Béhéra.

FRANCE.

GIRONDE :—
Bègles, and
Cadanjac,
in the neighbourhood of Bordeaux.

GERMANY.

PRUSSIA (POMERANIA) :—
Greifswald.
Köslin.
Schlawe.
Pyritz.
Rummelsburg.

HOLSTEIN :—
Tondorf.
Wandsbeck.
Wesselburen.

NETHERLANDS.

Drenthe.
Friesland.
Groningen.
Limburg.
North Brabant.
North Holland.
South Holland.
Utrecht.

SWITZERLAND.

Fribourg.
Thurgovie.
Valais.
Vaud.

TURKEY.

ROUMELIA :—
Salonica.

FOOT-AND-MOUTH DISEASE.

Foot-and-Mouth Disease was reported to have occurred in the following places : —

GERMANY.

Hamburg.

ITALY.

Naples.

PORTUGAL.

LISBON,
District of.
MADEIRA,
Island of.

SWITZERLAND.

In most of the Cantons.

TUNIS.

SHEEP-POX.

Sheep-pox was reported to have occurred in the following places :—

GERMANY.

PRUSSIA (POMERANIA) :—
Anklam.
Belgard.
Bublitz.
Bütow.
Demmin.
Dramburg.
Franzburg.
Greifenberg.
Greifswald.
Grimmen.
Kammin.
Kolberg.
Lauenburg.
Naugard.
Pyritz.
Regenwalde.
Rügen.
Rummelsburg.
Saatzig.
Schlawe.
Schwelbein.
Stolf.
Usedom Wollin.

TURKEY.

BAGDAD,
District of.
MITYLENE,
Island of.

ROUMANIA :—
Jalonitza.

SIVAS.

THESSALY.

SHEEP-SCAB.

Sheep-scab was reported to have occurred in the following places :—

GERMANY.

PRUSSIA (POMERANIA) :—
Belgard.
Bublitz.
Bütow.
Greifenberg.
Greifenhagen.
Kammin.
Kolberg.
Köslin.
Naugard.
Neu-Stettin.
Pyritz.
Randow.
Regenwalde.
Rummelsburg.
Saatzig.
Schlawe.
Schwelbein.
Stolf.
Ückermünde.
Usedom Wollin.

GLANDERS.

Glanders was reported to have occurred in the following places :—

GERMANY.

PRUSSIA (POMERANIA) :—
Franzburg.
Greifswald.
Rügen.
Stralsund.

APPENDIX.

Orders of Council in operation on the 31st December 1874.

List of Orders of Council

Issued under THE CONTAGIOUS DISEASES (ANIMALS) ACT, 1869, in operation on the 31st of December 1874.

Date.	Subject or Short Title.
10 August, 1869	Bristol—Limits of Port.
10 August, „	Dover—Limits of Port.
10 August, „	North Shields—Limits of Port.
10 August, „	Granton—Limits of Port.
10 August, „	Leith—Limits of Port.
10 August, „	Portsmouth—Limits of Port.
10 August, „	Dartmouth—Limits of Port.
10 August, „	Littlehampton—Limits of Port.
10 August, „	Goole—Limits of Port.
28 September, „	Portsmouth—Limits of Port—Amendment.
28 September, „	North Shields—Limits of Port—Amendment.
16 December, „	Hartlepool—Limits of Port.
12 January, 1870	Glasgow—Limits of Port.
17 June, „	Grimsby—Limits of Port.
1 October, „	Middlesbrough—Limits of Port.
1 October, „	Southampton—Limits of Port.
27 October, „	Plymouth—Limits of Port.
31 March, 1871	The Transit of Animals (Water) Order of March, 1871.
28 September, „	Newcastle-upon-Tyne—Limits of Port.
23 November, „	Sunderland—Limits of Port.
20 December, „	The Animals Order of 1871.
20 December, „	The Foreign Animals Order of 1871.
20 December, „	London—Limits of Port.
20 December, „	Hull—Limits of Port.
29 December, „	London—Foreign Cattle Market—Approval.
11 July, 1872	The Carcases of Animals Order of 1872.
15 July, „	Belgium—Importation.
19 July, „	Russia—Importation.
6 August, „	France—Importation.
8 August, „	The Markets Order of 1872.
5 November, „	Barrow-in-Furness—Importation.
30 June, 1873	Glanders and Farcy.
2 August, „	The Animals (Amendment) Order of 1873.
25 September, „	Southampton—Limits of Port—Amendment.
3 June, 1874	The Foot-and-Mouth Disease Order of 1874.
7 August, „	The Animals Amendment Order of 1874.

Countries comprised in the Second Schedule to O.C.No.342.

Countries which, on the 31st of December 1874, were comprised in the Second Schedule to **The Foreign Animals Order of 1871.**

*The Dominions of the Emperor of Russia.
The Austrian-Hungarian Empire.
The Empire of Germany.
The Dominions of the Sultan.
The Dominions of the King of Italy.
The Dominions of the King of the Hellenes.
†Belgium.
‡France.

* *The importation into Great Britain of Cattle from Russia is now prohibited by Order of* 19 *July* 1872 (*No.* 351).
† *Belgium added to Schedule by Order of* 15 *July* 1872 (*No.* 350).
‡ *France added to Schedule by Order of* 6 *August* 1872 (*No.* 354).

Ports where Foreign Animals may be landed.

Ports in **Great Britain** at which **Foreign Animals** may be landed.

Barrow-in-Furness.
*Bristol.
Cardiff.
*Dartmouth.
*Dover.
Falmouth.
Folkestone.
*Glasgow.
*Goole.
Grangemouth.
*Granton.
*Grimsby.
*Hartlepool.
Harwich.
*Hull.
Kirkwall.
*Leith.
*Littlehampton.
Liverpool.
*London.
*Middlesbrough.
*Newcastle-upon-Tyne.
Newhaven.
Penzance.
*Plymouth.
*Portsmouth.
*Shields, North.
Shields, South.
Shoreham.
*Southampton.
*Sunderland.
Weymouth.

Cattle from the Countries comprised in the Second Schedule to The Foreign Animals Order of 1871 *can only be landed at the Ports marked thus* *, *such Ports having parts specially defined for the purpose.*

APPENDIX.

Orders of Council issued in 1874.

Orders of Council

Issued during the Year 1874 under The Contagious Diseases (Animals) Act, 1869.

(370.)

AT the *Council Chamber, Whitehall*, the 27th day of *February*, 1874.

By the Lords of Her Majesty's Most Honourable Privy Council.

PRESENT:

Lord President.
Mr. Secretary Cross.

THE Lords and others of Her Majesty's Most Honourable Privy Council, by virtue and in exercise of the powers in them vested under The Contagious Diseases (Animals) Act, 1869, and of every other power enabling them in this behalf, do order, and it is hereby ordered, as follows:

1. This Order shall take effect from and immediately after the twenty-seventh day of February, one thousand eight hundred and seventy-four, and shall cease to have effect from and immediately after the thirtieth day of November, one thousand eight hundred and seventy-four.

2. This Order may be cited as The Schleswig-Holstein Order of 1874.

3. This Order extends to Great Britain only.

4. In this Order—

The Act of 1869 means The Contagious Diseases (Animals) Act, 1869:

A defined part of a port means a part of a port defined by a special Order of the Privy Council in pursuance of Regulation 2 of the Fourth Schedule to the Act of 1869:

Landing-place for slaughter means a landing-place within a defined part of a port:

Master includes any person having the charge or command of a vessel:

Other terms have the same meaning as in the Act of 1869.

5. Notwithstanding anything in The Foreign Animals Order of 1871, the regulations in the Fourth Schedule to the Act of 1869 shall not apply to cattle brought from a port in either of the parts of the German Empire respectively known as Schleswig and Holstein.

6. Cattle brought from a port of Schleswig or of Holstein shall not be landed elsewhere than at a landing-place for slaughter, unless and until the owner, agent, or charterer of the vessel in which they are brought has received the special permission of the Privy Council to employ the vessel in the trade of importation of cattle from ports of Schleswig and of Holstein or of either of them under this Order.

7. The landing of cattle brought from a port of Schleswig or of Holstein, elsewhere than at a landing-place for slaughter, shall be subject to the following conditions:—

First. That the vessel in which they are imported has not, within three months before taking them on board, had on board any cattle exported or carried coastwise from any port in any part of the German Empire, other than Schleswig or Holstein, or from any port of any of the following countries, namely:—

The Dominions of the Emperor of Russia.
The Austrian-Hungarian Empire.
The Dominions of the Sultan.
The Dominions of the King of Italy.
The Dominions of the King of the Hellenes.
Belgium.
France.

Secondly. That the vessel has not, since taking on board the cattle imported, entered any such port as aforesaid.

Thirdly. That the cattle imported have not, while on board the vessel, been in contact with any cattle exported or carried coastwise from any such port as aforesaid.

Fourthly. That the cattle imported are accompanied by a declaration and certificates, such as are indicated in the forms set forth in the schedule to this Order, or to the like effect.

8. Further, cattle brought from a port of Schleswig or of Holstein shall not be landed elsewhere than at a landing-place for slaughter, unless and until—

(1.) The owner or charterer of the vessel in which they are imported, or his agent in Great Britain, has entered into a bond to Her Majesty the Queen, in a sum not exceeding one thousand pounds, with or without a surety or sureties, to the satisfaction of the Commissioners of Her Majesty's Customs, conditioned for the observance of the foregoing conditions in relation to cattle to be landed under this Order from the vessel; and

(2.) The master of the vessel has on each occasion of importation of cattle therein satisfied the Commissioners of Her Majesty's Customs, or their proper officer, by declaration made and signed or otherwise, that none of the cattle then imported therein have been exported from any port in any part of the German Empire, other than Schleswig or Holstein, or from any port of any of the other countries named in Article 7 of this Order, and that the foregoing conditions have been observed in relation to all the cattle then imported therein.

9. If the Veterinary Inspector of the Privy Council is of opinion, on the examination of any cattle imported under this Order, that the declaration accompanying the cattle is untrue in any particular, as regards any one of the cattle in the vessel, then all the animals in the vessel shall be detained and dealt with in accordance with instructions from time to time given by the Privy Council.

10. If the declaration accompanying any cattle imported under this Order is untrue in any particular, as regards any one of the cattle to which it relates, the master of the vessel shall be guilty of an offence against this Order, unless he shows to the satisfaction of the Justices before whom he is charged, that he did not know of the same being so untrue, and that he could not with reasonable diligence have obtained such knowledge.

11. Subject to the provisions of this Order all the provisions of The Foreign Animals Order of 1871 shall continue to apply to cattle brought from a port of Schleswig or of Holstein.

(Signed) ARTHUR HELPS.

APPENDIX.

Orders of Council issued in 1874.

SCHEDULE.

Declaration and Certificates.

DECLARATION.

I, *A.B.*, of , being the Agent for the owners [*or* charterers] of the vessel , of , hereby solemnly and sincerely declare to the best of my knowledge and belief, that each of the cattle described below, now about to be put on board the said vessel, has been bred and fed exclusively in Denmark, Schleswig, and Holstein, or some or one of them, and has never been in contact with cattle not so exclusively bred and fed, and has not within the last three months been carried at sea on any vessel.

Dated this day of .

[To be signed] *A.B.*

Description of Cattle above referred to.

	Number.*
Bulls	
Oxen	
Cows	
Calves	

* Number to be expressed both in words and in figures.

CERTIFICATE BY CONSULAR OFFICER.

I, *C.D.*, Vice-Consul [*or as the case may be*] of Her Britannic Majesty at the Port of Husum [*or as the case may be*], hereby certify that the foregoing declaration was made by the above-named *A.B.* before me, this day of , 1874, and that I know the said *A.B.*, and that he is worthy of belief.

[To be signed] *C.D.*
[and Consular Seal to be affixed.]

CERTIFICATE BY OFFICER OF ROYAL PRUSSIAN PROVINCIAL COUNCIL OFFICE.

I, *X.Y.*, hereby certify that I have this day seen the cattle above described, and that I believe the statements respecting the breeding, feeding and carrying of each of them contained in the foregoing declaration of *A.B.* to be true in all respects.

[To be signed] *X.Y.*,
Officer of Royal Prussian Provincial Council Office, at the Port of Husum [*or as the case may be*].

(371.)

AT the *Council Chamber, Whitehall,* the 3rd day of *June*, 1874.

By the Lords of Her Majesty's Most Honourable Privy Council.

PRESENT:

Lord President.
Lord Sandon.

THE Lords and others of Her Majesty's Most Honourable Privy Council, by virtue and in exercise of the powers in them vested under The Contagious Diseases (Animals) Act, 1869, (in this Order referred to as the Act of 1869,) and of every other power enabling them in this behalf, do order, and it is hereby ordered, as follows:

1. This Order may be cited as The Foot-and-Mouth Disease Order of 1874.

2. Words in this Order have the same meaning as in the Act of 1869.

3. Articles 19, 27, and 28 of The Animals Order of 1871, shall have effect as if The Animals (Amendment) Order of 1873 had not been made.

4. Nothing in this Order shall revive any Regulation made by a Local Authority which was revoked by The Animals (Amendment) Order of 1873.

5. Article 28 of The Animals Order of 1871 shall extend to authorise a Local Authority to make regulations for prohibiting or regulating the movement, as therein provided, of any animal affected with foot-and-mouth disease; but nothing in this Order, or in any regulation of a Local Authority thereunder, shall be deemed to authorise the movement of any animal in contravention of section fifty-seven, or of any other provision of the Act of 1869.

6. Article 5 of The Animals (Amendment) Order of 1873 is hereby revoked.

Where an animal becomes affected with foot-and-mouth disease while exposed or placed or being carried, led, or driven, as in section fifty-seven of the Act of 1869 mentioned, it may, notwithstanding anything in that section, be, with a licence of an Inspector of the Local Authority authorised to issue the same, but not otherwise, moved for purposes of feeding, or watering, or other ordinary purposes connected with the breeding or rearing of animals, to any land or building in the occupation of the owner of the animal, or for slaughter to the nearest slaughter-house or some other slaughter-house approved by the Local Authority.

The form given in the Schedule to this Order, or a form to the like effect, with such variations as circumstances require, shall be used.

(Signed) ARTHUR HELPS.

APPENDIX.

Orders of Council issued in 1874.

* No.

Dated this of 18 .

Name and address of owner, or his or her agent -

Number of animals

Description of ditto

Route

From

Through

To

Purposes

[To be signed]

* This number must correspond with that on the licence.

This counterfoil is to be retained by the person granting the licence.

Caution.—Persons fabricating or altering or committing other offences with respect to licences are liable, under The Contagious Diseases (Animals) Act, 1869, to fine or imprisonment.

SCHEDULE.

Form of Licence.

FOOT-AND-MOUTH DISEASE.

Movement Licence.

* No.

I, *A.B.*, of , being an Inspector authorised by the Local Authority of the of to issue licences under Article of The Foot-and-Mouth Disease Order of 1874, for the movement of animals becoming affected with foot-and-mouth disease while exposed or placed or being carried, led, or driven, as mentioned in Section 57 of The Contagious Diseases (Animals) Act, 1869, hereby license the person undermentioned, being the owner of the undermentioned animals, or his [*or* her] agent, to move the said animals from to by the undermentioned route for the undermentioned purposes.

Number and Description of Animals.	Name and Address of Owner, or his or her Agent.	Route to be taken.	Purposes for which Movement is Licensed.	Remarks.
		From Through To		

The time allowed for removals under this licence is two days, from and after to-day.

[To be signed]

Inspector.

Dated this day of 18 .

* This number must correspond with that on the counterfoil.

Caution.—Persons fabricating or altering or committing other offences with respect to licences are liable, under The Contagious Diseases (Animals) Act, 1869, to fine or imprisonment.

(372.)

AT the *Council Chamber, Whitehall*, the 7th day of *August*, 1874.

By the Lords of Her Majesty's Most Honourable Privy Council.

PRESENT:

Lord President.
Lord Sandon.

THE Lords and others of Her Majesty's Most Honourable Privy Council, by virtue and in exercise of the powers in them vested under The Contagious Diseases (Animals) Act, 1869, and of every other power enabling them in this behalf, do declare and order, and it is hereby declared and ordered, as follows:

1. This Order may be cited as The Animals (Amendment) Order of 1874.

2. In this Order the Act of 1869 means The Contagious Diseases (Animals) Act, 1869; and words in this Order have the same meaning as in that Act.

3. The Foreign Animals Order of 1871 has and shall have effect subject and by way of supplement to The Animals Order of 1871; and nothing in The Foreign Animals Order of 1871 interferes or shall interfere with the execution or discharge by the Local Authority, or the inspector or other officer of the Local Authority, of any power or duty conferred or imposed on them or him by the Act of 1869, or by any Order of Council.

4. Regulation Seven of the Fourth Schedule to the Act of 1869 shall apply in every case where a vessel comes into port having on board foreign animals maimed or injured on the voyage; but, notwithstanding anything in Section Nineteen of the Act of 1869, any animals being at any time within any such port shall not be deemed foreign animals, by reason only of anything in this Order.

5. The Order of Council of the 30th day of June 1873, relating to glanders and farcy, shall have effect as if in Article Two thereof the word glanders were substituted for the words contagious or infectious disease.

(Signed) ARTHUR HELPS.

CORRESPONDENCE.

APPENDIX.

Local Government Board.

LOCAL GOVERNMENT BOARD.

The Secretary, Veterinary Department, to the Secretary, Local Government Board.

SIR, 20th December 1873.

I BEG to transmit herewith copy of a letter received from the Deputy Clerk of the Peace, Hertfordshire, enclosing copy of a letter from Dr. Ogle, referring to the carcases of cattle which have been slaughtered on account of being affected with pleuro-pneumonia. I beg also to enclose copy of a letter to the Clerk of the Peace, Wiltshire, from this Department, showing the views which have been held by the Lords of the Council on the question of the use for human food of such carcases.

I am directed to request that I may be favoured, for the information of the Lords of the Council, with the views of the Local Government Board on the question of the fitness, or otherwise, of the carcases of cattle, so slaughtered as above mentioned for human food; as, if Dr. Ogle's views be correct, it will be necessary for their Lordships to modify the opinion which has hitherto been given to local authorities on the point at issue.

I am, &c.

ENCLOSURE 1.

Clerk of the Peace Office,
St. Alban's, Herts,
SIR, 18th December 1873.

THE Executive Committee for this county, being desirous of a professional opinion as to whether the carcases of animals which have died of, or been slaughtered in consequence of being affected with, pleuro-pneumonia, are fit for human food, applied to Dr. Ogle, the medical officer of health for the union of Hertford, and of other adjoining unions, for his opinion upon the subject. I beg to enclose for your perusal, a copy of Dr. Ogle's reply. The Committee have heretofore proceeded upon the assumption that in ordinary cases such carcases are not unfit for human food, and in assessing the amount of compensation to be paid to the owner in cases of slaughter, have estimated the value of a carcase according to its supposed worth as butcher's meat. If, however, such carcases are not fit for human food it would seem that the Committee should in future discourage the sale of the carcase as butcher's meat, by treating it as only fit for dog's meat, or for destruction altogether. This course would considerably increase the charge upon the ratepayers in respect of compensation.

I am, &c.
(Signed) EDWARD WILLIAM BEAL,
Deputy Clerk of the Peace.

Alexander Williams, Esq.,
Veterinary Department.

ENCLOSURE 2. (Forwarded with Enclosure 1.)

Oxford and Cambridge Club,
SIR, Pall Mall, S.W., 16th December 1873.

ALTHOUGH as Medical Officer of Health I cannot recognize the right of any county committee to apply to me for a professional opinion, yet I am perfectly willing unofficially to answer the question put to me in your letter of 10th December.

The evidence as to the unwholesomeness of the flesh of animals that have been affected at the time of death with pleuro-pneumonia is so contradictory that, though I am personally inclined to believe such meat to be unwholesome, I should hesitate much before condemning it on that ground alone.

But meat may be "unfit for human food" without being demonstrably unwholesome. The Act unequivocably recognises unsoundness or disease, independently of unwholesomeness, as a sufficient ground for seizing and destroying meat. (See 26 & 27 Vict. c. 117. s. 2.) And the Order of the Local Government Board, in which the duties of Medical Officers of Health are defined, repeats the words of the Act. (See Sect. IV., Clause 8.)

As Medical Officer, therefore, bound by that Order, I have no option, but am fixed to consider such a carcase "unfit for human consumption."

I am, &c.
(Signed) WM. OGLE.

The Clerk of the Peace.

ENCLOSURE 3.

Privy Council Office, Veterinary Department,
Princes Street, Westminster, S.W.,
SIR, 21st August 1873.

I BEG to acknowledge the receipt of your letter of yesterday's date, inquiring as to the disposal of carcases of cattle slaughtered on account of pleuro-pneumonia, under the provisions of The Animals (Amendment) Order of 1873, which comes into force on the 1st proximo.

In reply, I beg to state that the carcases of cattle that have been affected with pleuro-pneumonia, (as well as the skins, horns, &c.) belong to the owner of such cattle, and that they may, if fit for human food, be sold by him for his own benefit; but that as the amount of compensation is left to the discretion of the Local Authority, only fixing the maximum, the Local Authority are at liberty, if they think fit, to take into consideration the value of the carcase. Should the Local Authority consider any carcases of cattle so slaughtered to be unfit for human food, it would appear to be necessary for their Officer to communicate with the Inspector of Nuisances, in order to prevent the sale of such carcases, but neither The Contagious Diseases (Animals) Act, 1869, nor the Orders of Council issued thereunder, lay down any regulation for the destruction of such carcases. I may, however, draw your attention to the fact that Article 30 of The Animals Order of 1871 empowers a Local Authority to make regulations for prohibiting or regulating the movement out of any field, &c., of the carcases of any cattle which have been slaughtered in consequence of being affected with pleuro-pneumonia.

I am, &c.
(Signed) C. EARDLEY-WILMOT,
for Secretary.

The Clerk of the Peace for
the county of Wilts, Marlborough.

The Secretary, Local Government Board, to the Secretary, Veterinary Department.

SIR, 12th January 1874.

I AM directed by the Local Government Board to acknowledge the receipt of your letter of the 20th ultimo, transmitting a copy of a correspondence which has taken place between the Veterinary Department of the Privy Council, and the Deputy Clerk of the Peace for Hertfordshire, as to the fitness of the carcases of cattle slaughtered on account of being affected with pleuro-pneumonia, for human food; and, requesting to be furnished with the views of the Board on the subject.

In reply, I am directed to state, for the information of the Lords of the Council, that the Board are not possessed of any conclusive evidence that the flesh of pleuro-pneumonia animals is hurtful. They are, however, advised by their Medical Officer that it is unsafe for use as human food; and, further, that the flesh of any animal with a febrile infection (such as pleuro-pneumonia) may properly be considered "diseased meat."

I am, &c.

The Secretary, Veterinary Department, to the Secretary, Local Government Board.

SIR, 26th January 1874.

I AM directed by the Lords of the Council to acknowledge the receipt of your letter of the 12th instant, furnishing me with the views of the Local Government Board as to the fitness, for human food, of the carcases of cattle slaughtered on account of being affected with pleuro-pneumonia.

In reply, I am directed to state, that their Lordships learn with great regret that your Board is advised that the flesh of animals which have been the subjects of any febrile disease should be considered unsafe for food.

If the carcases of such animals are to be condemned the loss will necessarily fall very heavily on the community. During the year 1873 this loss would probably have amounted to 10,000 head of

Local Government Board.

cattle from pleuro-pneumonia alone, and, if the Local Authorities effectually carry out the suggestions contained in the circular issued by this Department (copy enclosed*), the flesh of all animals classed under lot A. will have to be dealt with as diseased meat. In years when foot-and-mouth disease is prevalent the loss would be still greater: in 1871, the last year that returns of foot-and-mouth disease were furnished to this Department, the number of animals attacked in Great Britain amounted to 692,464.

It is to be feared that the result of any great destruction of meat will frustrate, to a great extent, the efforts which are being made for checking the spreading of pleuro-pneumonia among cattle in this country, as the owners would not, in many instances, give notice of the existence of disease among their stocks, if the present rate of compensation is maintained; and, if a higher rate of compensation were contemplated, entailing a larger outlay as well as a greater loss of meat, the Lords of the Council would hesitate to continue their Order rendering it compulsory to slaughter all cattle affected with pleuro-pneumonia.

With regard to Dr. Ogle's interpretation of section 2 of The Nuisances Removal Act for England (Amendment) Act, 1863, referred to in my letter of the 20th December last, I am directed to state that the Lords of the Council fail to perceive that a Medical Officer, or an Inspector of Nuisances, is justified in basing his opinion as to the unfitness for human food on the history of the meat inspected and his own view of the facts of that history. It would appear by that section that he is only authorised to inspect and examine and to form his opinion on the appearance presenting itself to him on that inspection and examination.

I am directed, therefore, to request that you will have the goodness to bring this subject again under the consideration of your Board, with a view to a possible modification of the opinion as expressed in your letter, especially as it is stated that the Local Government Board "are not possessed of any conclusive evidence that the flesh of pleuro-pneumonia animals is hurtful."

I am, &c.

The Secretary, Local Government Board, to the Secretary, Veterinary Department.

SIR, 30th April 1874.

I AM directed by the Local Government Board to acknowledge the receipt of your letter, &c., &c.

The Board have carefully reconsidered the subject referred to, and they direct me to state, for the information of the Lords of the Council, that in using the word "unsafe," in relation to the use of the flesh of animals which have been the subject of pleuro-pneumonia, the Board intended to state, that although they had no positive evidence of such meat being hurtful, they could not undertake to warrant it as incapable of doing harm; and the further statement "that the flesh of any animal with a febrile infection, (such as pleuro-pneumonia) may properly be called diseased meat," was intended to intimate the opinion, that such flesh may, in strictness, be held to be within the sense of the second part of Dr. Ogle's letter; the view expressed in which, it was considered, they could not, in the present state of the law, and with their present want of certainty on the main question, properly controvert.

I am, therefore, directed to observe, that while in the face of experience it cannot be broadly laid down that the flesh of animals, attacked with pleuro-pneumonia, is unfit for human food, or injurious to health, it would be impossible for this Department, as advised by their Medical Officer, to state the converse proposition affirmatively. On the whole, the Board see no sufficient reason for interfering with the practice hitherto prevailing on the subject.

I am, &c.

ADMIRALTY.

Admiralty.

The Superintendent of Victualling (Admiralty), to the Clerk of the Council.

SIR, 20th May 1874.

I AM commanded by my Lords Commissioners of the Admiralty to request that they may be favoured with the opinion of the Veterinary Department of the Privy Council Office as to whether the flesh of oxen affected by lung disease is fit for issue to the seamen of the fleet.

I am, &c.

The Clerk of the Council, to the Superintendent of Victualling (Admiralty).

SIR, 5th June 1874.

IN reply to your letter of the 20th ultimo, requesting to be favoured with the opinion of the Veterinary Department of the Privy Council Office, as to whether the flesh of oxen affected by lung disease is fit for issue to the seamen of the fleet, I beg to transmit herewith, for the information of the Lords Commissioners of the Admiralty, copy of a Report on the subject by the Inspectors attached to the Veterinary Department.

I am, &c.

ENCLOSURE.

29th May 1874.

MEMORANDUM.—In reference to the question as to the use of the flesh of cattle, affected with pleuro-pneumonia, for food; we are of opinion that if the animal be slaughtered when the disease is in the primary stage, and before any exudation has taken place into the areolar tissues of the body, the flesh is fit for human food; and we can state, as a matter of fact, that numbers of cattle suffering from pleuro-pneumonia are sold to butchers for the purpose of being used for food. In some stages of the disease, however, the flesh of animals affected with pleuro-pneumonia is unfit for human food, and as the question put by the Admiralty refers to the disease in the absolute, without any qualification as to degree, we are of opinion that it should be answered in the negative.

(Signed) G. T. BROWN.
ALEXR. C. COPE.

The Secretary,
&c. &c.

---

* See page 36 for copy of the Circular referred to.

Appendix.

Pleuro-Pneumonia. Circular to Local Authorities.

CIRCULAR LETTER issued to the LOCAL AUTHORITIES in GREAT BRITAIN on the subject of Slaughter and Isolation in cases of PLEURO-PNEUMONIA.

Veterinary Department, Privy Council Office,
Princes Street, Westminster, S.W.,
16th January 1874.

SIR,

THE attention of the Lords of the Council has been drawn to the continued prevalence of contagious pleuro-pneumonia among cattle, notwithstanding that the compulsory slaughter of all cattle affected with the disease has been ordered by Article 3 of The Animals (Amendment) Order of 1873.

Their Lordships are of opinion that this prevalence is to a great extent due to delay in carrying into effect the slaughter of affected cattle, and to absence of effectual observance of Article 19 of The Animals Order of 1871, which provides for the separation of diseased animals from animals not diseased.

Their Lordships are advised that a large amount of this disease might be prevented if the provisions respecting slaughter and isolation were carried into effect in the following manner:

1. Cattle affected with pleuro-pneumonia to be slaughtered *with the least possible delay.*
2. The internal temperature of each animal within reach of the contagion to be accurately ascertained, and the herd to be divided into two lots, to be effectually separated from each other:

Lot A to consist of those animals whose internal temperature is ascertained to be above 103° Fahr. These animals to be slaughtered *with the least possible delay* if more positive symptoms of pleuro-pneumonia present themselves.

Lot B to consist of the remainder of the herd. These animals to be examined with the thermometer weekly, and to be forthwith transferred to lot A in each case if the temperature is found to be above 103° Fahr.

I am directed to request that you will bring this letter before your Local Authority.

I am, &c.
(Signed) ALEXANDER WILLIAMS,
Secretary.

---

ro-
monia.
ber of
le
htered
Com-
ation
rded.

RETURN of the NUMBER of CATTLE affected with PLEURO-PNEUMONIA slaughtered by order of LOCAL AUTHORITIES during the Twelve Months ending the 31st of August 1874, and the AMOUNT of COMPENSATION awarded.

Note.—Although some of the cattle included in this Return died before the orders for slaughter could be carried out, compensation was in some instances allowed.

Local Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded.			Remarks.
		£	*s.*	*d.*	
ENGLAND AND WALES.					
Anglesey	Nil.	—			
Beaumaris	,,	—			
Bedford	21	136	5	0	
Bedford	Nil.	—			
Dunstable	,,	—			
Berks	44	265	15	0	
Abingdon	Nil.	—			
Maidenhead	- -	-	-	-	No reply.
Newbury	- -	-	-	-	No reply.
Reading	Nil.	—			
Wallingford	,,	—			
Windsor	,,	—			
Brecon	,,	—			
Brecon	,,	—			
Bucks	77	600	14	5	
Buckingham	Nil.	—			
Chipping Wycombe	,,	—			
Cambridge	- -	-	-	-	Information incomplete.
Cambridge	5	60	12	0	
Cardigan	Nil.	—			
Aberystwith	,,				
Cardigan	- -	-	-	-	No reply.
Carmarthen	Nil.	—			
Carmarthen	,,	—			
Llandovery	,,	—			
Carnarvon	Nil.	—			
Carnarvon	,,	—			
Pwllheli	,,	—			
Chester	131	965	6	6	Compensation withheld in respect of two cattle.
Birkenhead	Nil.	—			
Chester	,,	—			
Congleton	,,	—			
Macclesfield	,,	—			
Stockport	,,	—			
Cornwall	,,	—			
Bodmin	,,	—			
Falmouth	,,	—			
Helston	,,	—			
Launceston	,,	—			
Liskeard	,,	—			
Penryn	,,	—			
Penzance	,,	—			
St. Ives	,,	—			
Truro	10	43	0	0	
Cumberland	53	559	2	6	
Carlisle	1	6	10	0	
Denbigh	1	7	0	0	
Denbigh	Nil.	—			
Ruthin	- -	-	-	-	No reply.
Wrexham	3	21	5	0	
Derby	79	767	16	0	
Chesterfield	Nil.	—			
Derby	1		-	-	Compensation was n claimed, the owner the animal havin been prosecuted.
Glossop	Nil.	—			

Return of the Number of Cattle affected with Pleuro-Pneumonia slaughtered, &c.—*continued.*

APPENDIX.

Pleuro-Pneumonia. Number of Cattle slaughtered and Compensation awarded.

ocal Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded. £	s.	d.	Remarks.
	15	128	5	0	
rnstaple	Nil.	—			
deford	„	—			
rtmouth	- -	-	-	-	No reply.
evonport	Nil.	—			
eter	„	—			
niton	„	—			
ymouth	„	—			
uth Molton	„	—			
verton	„	—			
rrington	„	—			
tnes	„	—			
	5	45	0	0	
andford	Nil.	—			
idport	„	—			
rchester	„	—			
me Regis	„	—			
ole	„	—			
aftesbury	- -	-	-	-	No reply.
eymouth	Nil.	—			
n	19	167	15	0	7*l*.10*s*. of this amount had not been claimed at the date of latest information.
rlington	- -	-	-	-	No reply.
rham	Nil.	—			
teshead	„	—			
rtlepool	„	—			
uth Shields	„	—			
ockton-upon-Tees	„	—			
nderland	„	—			
	339	1,821	5	0	Compensation disallowed in respect of three cattle.
lchester	Nil.	—			
rwich	- -	-	-	-	No reply.
ldon	- -	-	-	-	No reply.
ffron Walden	- -	-	-	-	No reply.
	1	15	0	0	
nt	Nil.	—			
gan	„	—			
eravon	„	—			
rdiff	„	—			
ath	„	—			
vansea	- -	-	-	-	No reply.
ster	Nil.	—			
istol	„	—			
oucester	„	—			
wkesbury	„	—			
	121	1,249	2	6	
dover	Nil.	—			
singstoke	„	—			
mington	„	—			
wport	„	—			
rtsmouth	„	—			
omsey	„	—			
de	„	—			
uthampton	„	—			
inchester	„	—			
rd	29	184	15	0	
ereford	Nil.	—			
ominster	„	—			
	124	652	10	4	
ertford	Nil.	—			
	98	718	10	0	
odmanchester	3	23	0	0	
untingdon	Nil.	—			

Local Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded. £	s.	d.	Remarks.
Kent	255	1,723	10	0	
Canterbury	Nil.	—			
Deal	„	—			
Dover	„	—			
Faversham	„	—			
Folkestone	2	22	0	0	
Gravesend	Nil.	—			
Hythe	„	—			
Maidstone	„	—			
Margate	„	—			
Ramsgate	„	—			
Rochester	„	—			
Sandwich	„	—			
Tenterden	„	—			
Tonbridge Wells	„	—			
Lancaster	196	1,422	7	9	
Ashton-under-Lyne	Nil.	—			
Barrow-in-Furness	„	—			
Blackburn	„	—			
Bolton	9	82	0	0	
Bootle-cum-Linacre	Nil.	—			
Burnley	„	—			
Clitheroe	„	—			
Lancaster	„	—			
Liverpool	2	15	0	0	
Manchester	7	52	5	0	
Oldham	1	-	-	-	Compensation was not claimed, the owner of the animal having been prosecuted.
Preston	Nil.	—			
Rochdale	14	124	5	0	
St. Helen's	Nil.	—			
Salford	2	21	0	0	
Southport	Nil.	—			
Stalybridge	„	—			
Warrington	„	—			
Wigan	- -	-	-	-	No reply.
Leicester	- -	-	-	-	Information incomplete.
Leicester	3	19	0	0	
Liberty of Isle of Ely	102	555	2	3	
Wisbech	Nil.	—			
Liberty of St. Albans	36	177	0	6	
St. Albans	Nil.	—			
Lincoln (Parts of Holland)	- -	-	-	-	No reply.
Boston	Nil.	—			
Lincoln (Parts of Kesteven)	26	154	5	0	Information as to additional compensation in respect of four cattle incomplete.
Grantham	Nil.	—			
Stamford	„	—			
Lincoln (Parts of Lindsey)	17	139	0	0	
Grimsby, Great	1	7	10	0	
Lincoln	Nil.	—			
Louth	1	9	0	0	
Merioneth	Nil.	—			
Metropolis	339	1,456	10	8	
Middlesex	154	353	2	0	Compensation disallowed in respect of one animal. Owner prosecuted.
London, City of	Nil.	—			
Monmouth	7	54	0	0	
Monmouth	- -	-	-	-	No reply.
Newport	Nil.	—			
Montgomery	„	—			
Llanidloes	„	—			
Welshpool	„	—			

Return of the Number of Cattle affected with Pleuro-Pneumonia slaughtered, &c.—*continued.*

Local Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded. £	s.	d.	Remarks.
Norfolk	988	4,596	13	0	
King's Lynn	2	11	10	0	
Norwich	1	3	11	3	
Thetford	Nil.	—			
Yarmouth, Great	3	12	2	11½	
Northampton	153	882	16	5	
Daventry	Nil.	—			
Northampton	"	—			
Northumberland	32	263	7	6	
Berwick-upon-Tweed	Nil.	—			
Morpeth	"	—			
Newcastle-upon-Tyne	17	126	15	0	
Tynemouth	Nil.	—			
Notts	78	649	14	0	Information as to additional compensation in respect of five cattle incomplete.
Newark	Nil.	—			
Nottingham	"	—			
Retford, East	"	—			
Oxford	65	415	5	0	
Banbury	Nil.	—			
Chipping Norton	"	—			
Oxford	"	—			
Pembroke	-	-	-	-	No reply.
Haverfordwest	Nil.	—			
Pembroke	"	—			
Tenby	"	—			
Radnor	"	—			
Rutland	3	15	10	0	
Salop	-	-	-	-	No reply.
Bridgnorth	Nil.	—			
Ludlow	"	—			
Oswestry	"	—			
Shrewsbury	"	—			
Wenlock	"	—			
Soke of Peterborough	4	18	10	0	
Peterborough	Nil.	—			
Somerset	32	285	10	0	
Bath	9	102	10	0	
Bridgwater	Nil.	—			
Chard	"	—			
Glastonbury	"	—			
Wells	"	—			
Yeovil	"	—			
Stafford	134	1,285	4	4	Compensation disallowed in respect of one animal.
Hanley and Shelton	Nil.	—			
Lichfield	1	8	0	0	
Longton	Nil.	—			
Newcastle-under-Lyme	"	—			
Stafford	"	—			
Stoke-upon-Trent	-	-	-	-	No reply.
Tamworth	Nil.	—			
Walsall	2	22	5	0	
Wolverhampton	7	76	10	0	
Suffolk	-	-	-	-	Information incomplete.
Beccles	1	-	-	-	Information as to compensation incomplete.
Bury St. Edmunds	Nil.	—			
Eye	3	18	10	0	
Ipswich	-	-	-	-	No reply.
Southwold	Nil.	—			
Sudbury	1	5	0	0	
Surrey	140	1,348	17	0	
Godalming	Nil.	—			
Guildford	"	—			
Kingston-on-Thames	-	-	-	-	Information not yet received.
Reigate	1	15	0	0	
Sussex	108	808	15	0	
Arundel	Nil.	—			
Brighton	"	—			
Chichester	"	—			
Hastings	2	12	10	0	
Hove	Nil.	—			
Rye	"	—			
Warwick	113	940	15	0	
Birmingham	10	84	10	0	
Coventry	1	7	0	0	
Leamington	Nil.	—			
Stratford-on-Avon	"	—			
Warwick	-	-	-	-	No reply.
Westmorland	Nil.	—			
Kendal	"	—			
Wilts	34	317	10	0	
Calne	Nil.	—			
Chippenham	"	—			
Devizes	"	—			
Marlborough	"	—			
Salisbury (or New Sarum).	"	—			
Worcester	59	421	0	0	
Bewdley	Nil.	—			
Droitwich	1	6	10	0	An additional cl disputed in resp of two cattle.
Dudley	-	-	-	-	No reply.
Evesham	Nil.	—			
Kidderminster	"	—			
Worcester	"	—			
York (East Riding)	97	806	3	0	
Beverley	12	71	9	0	
Hedon	Nil.	—			
Kingston-upon-Hull	"	—			
York (North Riding)	145	1,145	9	0	Compensation w held in respect eight cattle. Owner prosecut
Middlesbrough	Nil.	—			
Richmond	"	—			
Scarborough	"	—			
York (West Riding)	474	3,588	10	1	
Barnsley	Nil.	—			
Batley	1	5	10	0	
Bradford	Nil.	—			
Dewsbury	"	—			
Doncaster	-	-	-	-	No reply.
Halifax	Nil.	—			
Huddersfield	"	—			
Leeds	5	48	0	0	
Pontefract	Nil.	—			
Ripon	4	33	5	0	
Rotherham	Nil.	-	-	-	Returns for Roth ham were inclu among those the county u after the 31st A gust 1874.
Sheffield	10	140	0	0	
Wakefield	Nil.	—			
York, City of	2	12	5	0	
SCOTLAND.					
Aberdeen	250	1,471	0	2	No claim made respect of animal.
Aberdeen	18	100	6	7	
Inverurie	Nil.	—			
Kintore	"	—			
Peterhead	11	67	11	0	
Argyle	6	37	10	0	
Campbelton	Nil.	—			
Inverary	"	—			
Oban	"	—			
Ayr	15	112	15	0	
Ayr	Nil.	—			
Irvine	"	—			
Kilmarnock	"	—			

Return of the Number of Cattle affected with Pleuro-Pneumonia slaughtered, &c.—*continued.*

Pleuro-Pneumonia. Number of Cattle slaughtered and Compensation awarded.

Local Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded. £	s.	d.	Remarks.
- - -	31	170	12	6	
Banff	Nil.	—			
Cullen	"	—			
ick	15	116	0	0	
Lauder	Nil.	—			
- - -	"	—			
ness	"	—			
Wick	"	—			
mannan	25	143	2	6	
arty	Nil.	—			
Cromarty	- -	-	-	-	No reply.
arton	9	72	0	0	
Dumbarton	Nil.	—			
ries	7	36	10	0	
Annan	- -	-	-	-	No reply.
Dumfries	Nil.	—			
Lochmaben	"	—			
Sanquhar	"	—			
urgh	187	1,021	17	1½	
Edinburgh	253	777	11	6	
Leith	39	348	0	0	
Musselburgh	Nil.	—			
Portobello	"	—			
or Moray	4	35	0	0	
Elgin	Nil.	—			
Forres	"	—			
- - -	81	490	14	0	
Anstruther, Easter	Nil.	—			
Anstruther, Wester	"	—			
Burntisland	"	—			
Crail	"	—			
Cupar	"	—			
Dunfermline	5	41	5	0	
Dysart	4	22	10	0	
nverkeithing	Nil.	—			
Kilrenny	"	—			
Kinghorn	"	—			
Kirkcaldy	5	42	5	0	
Pittenweem	- -	-	-	-	No reply.
St. Andrews	1	8	10	0	
r	- -	-	-	-	No reply.
Arbroath	10	54	4	2	
Brechin	- -	-	-	-	No reply.
Dundee	1	-	-	-	Compensation withheld.
Forfar	2	6	16	6	
Montrose	10	69	5	0	
ington	6	39	10	0	
Dunbar	Nil.	—			
Haddington	"	—			
North Berwick	"	—			
ness	16	111	16	6	
nverness	- -	-	-	-	No reply.

Local Authority.	No. of Cattle Slaughtered.	Amount of Compensation awarded. £	s.	d.	Remarks.
Kincardine	51	264	11	7	
Inverbervie	Nil.	—			
Kinross	7	32	12	6	
Kirkcudbright	14	77	10	0	
Kirkcudbright	- -	-	-	-	No reply.
New Galloway	Nil.	—			
Lanark	189	1,080	10	8	Information incomplete in respect of compensation for 11 cattle.
Airdrie	Nil.	—			
Glasgow	199	2,106	11	11½	
Hamilton	Nil.	—			
Lanark	"	—			
Rutherglen	20	215	3	3	
Linlithgow	20	93	0	0	
Linlithgow	Nil.	—			
Queen's Ferry	- -	-	-	-	No reply.
Nairn	Nil.	—			
Nairn	"	—			
Orkney	"	—			
Kirkwall	"	—			
Peebles	3	10	5	0	
Perth	107	394	7	6	
Culross	Nil.	—			
Perth	"	—			
Renfrew	38	220	10	9	
Greenock	10	100	4	6	
Paisley	26	143	18	6	
Port Glasgow	Nil.	—			
Renfrew	"	—			
Ross	40	360	0	0	
Dingwall	Nil.	—			
Fortrose	"	—			
Tain	"	—			
Roxburgh	9	63	15	0	
Hawick	Nil.	—			
Jedburgh	"	—			
Selkirk	"	—			
Galashiels	"	—			
Shetland	Nil.	—			
Stirling	6	42	12	6	
Falkirk	Nil.	—			
Stirling	2	13	10	0	
Sutherland	23	215	15	0	
Dornoch	Nil.	—			
Wigtown	14	115	10	0	
Stranraer	Nil.	—			
Whithorn	"	—			
Wigtown	"	—			
Total	6,898	44,384	11	2½	

STATISTICAL TABLES.

CONTENTS.

HOME ANIMALS.

	Table.	Pages.
Number of Animals in Great Britain, **in 1870, 1871, 1872, 1873, and 1874**	I.	43
,, ,, ,, **at the Metropolitan and Foreign Cattle Markets** ,, ,, ,, ,, ,, ,,	II.	44
Prices of Live Meat at the Metropolitan Cattle Market ,, ,, ,, ,, ,, ,,	III.	45
Quantity of Dead Meat at the Metropolitan Meat Market, in 1869, 1870, 1871, 1872, and 1873	IV.	46
Prices ,, ,, ,, ,, ,, ,, ,, ,, **in 1870, 1871, 1872, 1873, and 1874**	V.	46
,, ,, ,, ,, ,, **Liverpool** ,, ,, ,, ,, ,, ,,	VI.	47
,, ,, ,, ,, ,, **Glasgow** ,, ,, ,, ,, ,, ,,	VII.	47

Diseased Animals.

All Contagious Diseases:—

	Table.	Pages.
Yearly Results of each DISEASE in GREAT BRITAIN, in 1870, 1871, 1872, 1873, and 1874	VIII.	48
Proportion per Cent. of DISEASED Animals, amongst Home Animals, ,, ,, ,, ,, ,, ,, ,,	IX.	49
,, ,, ,, KILLED, DIED, and RECOVERED, in GREAT BRITAIN, in 1870, 1871, 1872, 1873, and 1874	X.	50
,, ,, ,, ,, ,, ,, ,, in ENGLAND, in WALES, and in SCOTLAND, in 1874	XI.	50
Animals Attacked, by each DISEASE, in each WEEK of the Year 1874, in ENGLAND, in WALES, and in SCOTLAND	XII.	51

Pleuro-Pneumonia:—

	Table.	Pages.
RESULTS in each COUNTY, in the Year 1874	XIII.	52–53
Number ATTACKED, in each COUNTY, in each WEEK, of the Year 1874	XIV.	54–55
,, KILLED, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,	XV.	56–57
,, DIED, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,,	XVI.	58–59
Cattle SLAUGHTERED HEALTHY to prevent the spread of PLEURO-PNEUMONIA, in each COUNTY, in each WEEK, of 1874	XVII.	60–61
WEEKLY Progress in GREAT BRITAIN, in the Year 1874	XVIII.	62

Sheep-Scab:—

	Table.	Pages.
WEEKLY Progress in GREAT BRITAIN, in the Year 1874	XIX.	63
RESULTS in each COUNTY, ,, ,, ,, ,,	XX.	64–65
Number ATTACKED, in each COUNTY, in each WEEK, of the Year 1874	XXI.	66–67

Glanders:—

	Table.	Pages.
RESULTS in each COUNTY, in the Year 1874	XXII.	68–69
Number ATTACKED, in each COUNTY, in each WEEK, of the Year 1874	XXIII.	70–71
,, KILLED and DIED, ,, ,, ,, ,, ,, ,, ,, ,, ,,	XXIV.	72–73
WEEKLY Progress in GREAT BRITAIN, in the Year 1874	XXV.	74

Farcy:—

	Table.	Pages.
WEEKLY Progress in GREAT BRITAIN, in the Year 1874	XXVI.	75
RESULTS in each COUNTY ,, ,, ,, ,,	XXVII.	76–77
Number ATTACKED, in each COUNTY, in each WEEK, of the Year 1874	XXVIII.	78–79
,, KILLED and DIED, ,, ,, ,, ,, ,, ,, ,, ,, ,,	XXIX.	80–81

Diseased and Injured Animals.

	Table.	Pages.
Carcases Destroyed by Horse Slaughterers in, or near the METROPOLIS, in 1870, 1871, 1872, 1873, and 1874	XXX.	82
,, ,, ,, ,, ,, ,, ,, ,, ,, ,, ,, the Year 1874	XXXI.	82

IMPORTED ANIMALS.

From Ireland.

	Table.	Pages.
nimals Imported into Great Britain, from Ireland, in 1870, 1871, 1872, 1873, and 1874	XXXII.	83

From Foreign Countries.

	Table.	Pages.
nimals Imported into Great Britain, from Foreign Countries, in 1870, 1871, 1872, 1873, and 1874	XXXIII.	83
„ „ „ London „ „ „ „ „ „ „ „ „ „	XXXIV.	83
„ „ „ each Port of Great Britain „ „ „ „ „ „ „	XXXV.	84–85
„ „ „ Great Britain from each Country „ „ „ „ „ „ „	XXXVI.	86–87
„ „ „ each Port of Great Britain, from each Country, in the Year 1874	XXXVII.	86–87
„ „ „ „ Wharf of the Port of London in 1870, 1871, 1872, 1873, and 1874	XXXVIII.	88
„ „ „ „ „ „ „ „ „ „ from each Country, in the Year 1874	XXXIX.	89
verage Value, per Head, of Foreign Animals Imported into the United Kingdom, from 1870 to 1874, inclusive	XL.	90
„ „ „ „ „ „ „ „ from each Country, in the year 1874	XLI.	90
roportion per Cent. of Foreign Animals imported from each Country in 1870, 1871, 1872, 1873, and 1874	XLII.	91
„ „ „ „ „ „ landed at each British Port „ „ „ „ „ „ „	XLIII.	92–93
„ „ „ „ „ „ from each Foreign Country to each British Port, in the Year 1874	XLIV.	94–95

From the Channel Islands.

	Table.	Pages.
nimals Imported into Great Britain, from the Channel Islands, in 1872, 1873, and 1874	XLV	96
„ „ „ each Port of Great Britain from each of the Channel Islands in the Year 1874	XLVI.	97

Diseased Animals from Foreign Countries.

	Table.	Pages.
umber Landed at each British Port, and Number from each Foreign Country in 1870, 1871, 1872, 1873, and 1874	XLVII.	98–99
„ „ „ „ „ „ from each Foreign Port, in the Year 1874. Detailed	XLVIII.	100–101
„ „ „ „ „ „ „ „ Foreign Country „ „ „ „ Summarized	XLIX.	102
roportion per Cent. of Diseased Foreign Animals brought from each Country in the Year 1874	L.	103
„ „ „ „ „ „ „ „ „ „ „ „ 1870, 1871, 1872, 1873, and 1874	LI.	104

Diseased and Injured Animals from Foreign Countries.

	Table.	Pages.
anded Dead or Slaughtered in Great Britain in 1872, 1873, and 1874	LII.	105
„ „ „ „ „ „ „ „ the Year 1874	LIII.	106–7
„ „ „ „ at the Port of London, in 1870, 1871, 1872, 1873, and 1874	LIV.	108
„ „ „ „ „ „ „ „ „ „ the Year 1874	LV.	109
„ „ „ „ „ „ 31 other Ports „ „ „ „	LVI.	110–11

IMPORTED MEAT.

	Table.	Pages.
Dead Meat Imported into Great Britain, from 1870 to 1874, showing each Kind of Meat	LVII.	112
„ „ „ „ the United Kingdom „ „ „ „ the Countries from which Exported	LVIII.	113
„ „ „ „ „ „ „ showing each Kind of Meat from each Country, in the Year 1874	LIX.	114

FOREIGN STATISTICS.

Supply and Prices of Meat in Austria and Germany.

	Table.	Pages.
Vienna :—Number of Animals at the Market, in 1872, 1873, and 1874	LX.	115
„ Wholesale and Retail Prices of Meat, in 1870, 1871, 1872, 1873, and 1874	LXI.	115
Chief Towns of Prussia :—Retail Prices of Meat, in September 1872, September 1873, and September 1874	LXII.	116
Berlin :—Number of Animals at the Market in 1871–2, 1872–3, and 1874	LXIII.	117
„ Wholesale Prices of Meat, in 1870, 1871, 1872, 1873, and 1874	LXIV	117
„ Retail „ „ „ „ „ „ „ „ „ „ „	LXV.	118
Frankfort-on-the-Maine :—Number of Animals at the Market, and Retail Prices of Meat, in 1873 and 1874	LXVI.	118
Dresden :— „ „ „ „ „ „ „ „ „ „ „ „ „ „ „	LXVII.	119
Munich :— „ „ „ „ „ „ „ „ „ „ „ „ „ „ „	LXVIII.	119
Hamburg :—Wholesale and Retail Prices of Meat, in 1870, 1871, 1872, 1873, and 1874	LXIX.	120

TABLE I.

TABLE showing the NUMBER of CATTLE, SHEEP, and SWINE in ENGLAND, in WALES, in SCOTLAND, and in GREAT BRITAIN respectively, on the 25th June, in each of the Years 1870, 1871, 1872, 1873, and 1874; and the YEARLY AVERAGE of the Five Years.

(*Compiled from the "Agricultural Returns" published yearly by the Board of Trade.*)

—	YEARS.	CATTLE.				SHEEP.			SWINE.	TOTAL NUMBER of Head of LIVE STOCK.
		Cows and Heifers in Milk, or in Calf.	Other Cattle.		TOTAL.	1 Year old, and above.	Under 1 Year old.	TOTAL.	TOTAL.	
			2 Years of Age, and above.	Under 2 Years of Age.						
ENGLAND -	1870	1,529,322	978,225	1,249,587	3,757,134	12,003,300	6,936,956	18,940,256	1,813,901	24,511,291
	1871	1,460,693	981,295	1,229,076	3,671,064	11,144,527	6,385,880	17,530,407	2,078,504	23,279,975
	1872	1,522,948	1,051,850	1,326,865	3,901,663	11,295,518	6,617,386	17,912,904	2,347,512	24,162,079
	1873	1,580,912	1,051,681	1,541,042	4,173,635	11,908,391	7,261,460	19,169,851	2,141,417	25,484,903
	1874	1,614,477	1,105,773	1,585,290	4,305,540	12,441,794	7,417,964	19,859,758	2,058,781	26,224,079
	Average	1,541,670	1,033,765	1,386,372	3,961,807	11,758,706	6,923,929	18,682,635	2,088,023	24,732,465
WALES - -	1870	256,485	123,232	225,032	604,749	1,891,556	814,923	2,706,479	198,547	3,509,775
	1871	250,551	118,005	228,032	596,588	1,885,839	820,576	2,706,415	225,456	3,528,459
	1872	250,663	108,712	243,363	602,738	1,965,876	901,268	2,867,144	238,317	3,708,199
	1873	259,612	107,094	276,151	642,857	2,050,297	916,565	2,966,862	211,174	3,820,893
	1874	263,616	125,289	276,200	665,105	2,111,069	953,627	3,064,696	213,754	3,943,555
	Average	256,186	116,466	249,755	622,407	1,980,927	881,392	2,862,319	217,450	3,702,176
SCOTLAND -	1870	375,997	254,536	410,901	1,041,434	4,515,394	2,235,460	6,750,854	158,690	7,950,978
	1871	380,189	257,477	432,441	1,070,107	4,541,186	2,341,561	6,882,747	195,642	8,148,496
	1872	391,516	261,338	467,739	1,120,593	4,699,573	2,441,886	7,141,459	185,920	8,447,972
	1873	396,990	261,014	490,053	1,148,057	4,819,068	2,471,854	7,290,922	147,668	8,586,647
	1874	395,704	278,562	480,580	1,154,846	4,895,867	2,493,620	7,389,487	150,297	8,694,630
	Average	388,079	262,586	456,343	1,107,008	4,694,218	2,396,876	7,091,094	167,643	8,365,745
GREAT BRITAIN -	1870	2,161,804	1,355,993	1,885,520	5,403,317	18,410,250	9,987,339	28,397,589	2,171,138	35,972,044
	1871	2,091,433	1,356,777	1,889,549	5,337,759	17,571,552	9,548,017	27,119,569	2,499,602	34,956,930
	1872	2,165,127	1,421,900	2,037,967	5,624,994	17,960,967	9,960,540	27,921,507	2,771,749	36,318,250
	1873	2,237,514	1,419,789	2,307,246	5,964,549	18,777,756	10,649,879	29,427,635	2,500,259	37,892,443
	1874	2,273,797	1,509,624	2,342,070	6,125,491	19,448,730	10,865,211	30,313,941	2,422,832	38,862,264
	Average	2,185,935	1,412,817	2,092,470	5,691,222	18,433,851	10,202,197	28,636,048	2,473,116	36,800,386

Note.—For the *Proportions per Cent.* of *Diseased* to Total Number of Animals in England, in Wales, in Scotland, and in Great Britain respectively, during each of the above Years, see Table IX.

TABLE II.

NUMBER of **CATTLE**, **SHEEP**, and **SWINE** brought into the METROPOLITAN CATTLE MARKET during each of the Years 1870 and 1871, and the Number brought into the METROPOLITAN CATTLE MARKET and into the FOREIGN CATTLE MARKET in 1872, 1873, and 1874, distinguishing the Home from the Foreign, and showing the Proportion per Cent. which the latter bear to the Total Number at the Market, or Markets.

YEARS.	NUMBER OF ANIMALS.			PROPORTION PER CENT. of FOREIGN ANIMALS.
	HOME.	FOREIGN.	TOTAL.	
		CATTLE.		
1870 - - -	162,831	109,447	272,278	40·197
1871 - - -	146,335	122,036	268,371	45·473
1872 - - -	178,969	*108,985	*287,954	37·848
1873 - - -	181,825	†120,385	†302,210	39·835
1874 - - -	186,992	‡126,255	‡313,247	40·305
		SHEEP.		
1870 - - -	1,152,193	484,555	1,636,748	29·605
1871 - - -	931,740	592,260	1,524,000	38·862
1872 - - -	800,100	*690,866	*1,490,966	46·337
1873 - - -	766,645	†695,044	†1,461,689	47·551
1874 - - -	999,185	‡650,464	‡1,649,649	39·430
		SWINE.		
1870 - - -	5,950	5,300	11,250	47·111
1871 - - -	7,299	990	8,289	11·944
1872 - - -	8,379	*213	*8,592	2·479
1873 - - -	7,795	†1,084	†8,879	12·209
1874 - - -	5,878	‡17,037	‡22,915	74·349

Note.—For the *Prices* of Meat at the Metropolitan Cattle Market, see Table III.

* Of these numbers, 38,426 Cattle, 122,601 Sheep, and 173 Swine were landed at the Foreign Cattle Market in 1872. (See Table XXXVIII.)

† Of these numbers, 7,090 Cattle, 2,339 Sheep, and 394 Swine were landed at the Foreign Cattle Market in 1873. (See Table XXXVIII.)

‡ Of these numbers, 7,175 Cattle, 114 Sheep, and 16,955 Swine were landed at the Foreign Cattle Market in 1874. (See Table XXXVIII.)

TABLE III.

AVERAGE PRICES of LIVE **MEAT** per lb., sinking the Offal, at the METROPOLITAN CATTLE MARKET for each Year from 1870 to 1874 inclusive.

YEARS.	INFERIOR QUALITY.			AVERAGE PRICES per lb.*	FIRST QUALITY.		
	AVERAGES of the				AVERAGES of the		
	LOWEST Prices.	MEAN Prices.	HIGHEST Prices.		LOWEST Prices.	MEAN Prices.	HIGHEST Prices.
BEEF.							
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1870 - -	$5\frac{3}{8}$	$6\frac{1}{16}$	$6\frac{3}{4}$	$6\frac{13}{16}$	$6\frac{7}{8}$	$7\frac{9}{16}$	$8\frac{1}{4}$
1871 - -	$5\frac{3}{4}$	$6\frac{7}{16}$	$7\frac{1}{8}$	$7\frac{1}{4}$	$7\frac{3}{8}$	$8\frac{1}{16}$	$8\frac{3}{4}$
1872 - -	$6\frac{1}{4}$	$6\frac{11}{16}$	$7\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{7}{8}$	$8\frac{5}{16}$	$8\frac{3}{4}$
1873 - -	$7\frac{5}{8}$	$7\frac{7}{8}$	$8\frac{1}{8}$	$8\frac{17}{32}$	$8\frac{7}{8}$	$9\frac{3}{16}$	$9\frac{1}{2}$
1874 - -	$6\frac{5}{8}$	$7\frac{1}{4}$	$7\frac{7}{8}$	$8\frac{1}{16}$	$8\frac{1}{2}$	$8\frac{7}{8}$	$9\frac{1}{4}$
MUTTON.							
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1870 - -	$5\frac{3}{8}$	$6\frac{1}{8}$	$6\frac{7}{8}$	7	$7\frac{1}{8}$	$7\frac{7}{8}$	$8\frac{5}{8}$
1871 - -	$6\frac{3}{8}$	$7\frac{1}{16}$	$7\frac{3}{4}$	$7\frac{31}{32}$	8	$8\frac{7}{8}$	$9\frac{3}{4}$
1872 - -	$7\frac{1}{4}$	$7\frac{5}{8}$	8	$8\frac{15}{32}$	$8\frac{5}{8}$	$9\frac{5}{16}$	10
1873 - -	$8\frac{1}{2}$	$8\frac{3}{4}$	9	$9\frac{13}{32}$	$9\frac{3}{4}$	$10\frac{1}{16}$	$10\frac{3}{8}$
1874 - -	$7\frac{1}{8}$	$7\frac{1}{2}$	$7\frac{7}{8}$	$8\frac{1}{32}$	$8\frac{3}{8}$	$8\frac{9}{16}$	$8\frac{3}{4}$
PORK.							
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1870 - -	$5\frac{3}{8}$	$6\frac{1}{16}$	$6\frac{3}{4}$	$6\frac{27}{32}$	7	$7\frac{5}{8}$	$8\frac{1}{4}$
1871 - -	$5\frac{1}{8}$	$5\frac{5}{8}$	$6\frac{1}{8}$	$6\frac{7}{32}$	$6\frac{3}{8}$	$6\frac{13}{16}$	$7\frac{1}{4}$
1872 - -	$5\frac{3}{8}$	$5\frac{11}{16}$	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{13}{16}$	$7\frac{1}{8}$
1873 - -	6	$6\frac{1}{4}$	$6\frac{1}{2}$	$6\frac{7}{8}$	$7\frac{1}{4}$	$7\frac{1}{2}$	$7\frac{3}{4}$
1874 - -	$5\frac{7}{8}$	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{11}{16}$	7	$7\frac{1}{4}$	$7\frac{1}{2}$
VEAL.							
	d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1870 - -	$5\frac{1}{4}$	$6\frac{1}{8}$	7	$7\frac{1}{16}$	$7\frac{1}{4}$	8	$8\frac{3}{4}$
1871 - -	$5\frac{3}{4}$	$6\frac{1}{2}$	$7\frac{1}{4}$	$7\frac{7}{16}$	$7\frac{1}{2}$	$8\frac{3}{8}$	$9\frac{1}{4}$
1872 - -	$6\frac{3}{4}$	$7\frac{3}{16}$	$7\frac{5}{8}$	8	$8\frac{1}{4}$	$8\frac{13}{16}$	$9\frac{3}{8}$
1873 - -	$7\frac{1}{8}$	$7\frac{5}{8}$	$8\frac{1}{8}$	$8\frac{11}{32}$	$8\frac{3}{4}$	$9\frac{1}{16}$	$9\frac{3}{8}$
1874 - -	$6\frac{7}{8}$	$7\frac{3}{16}$	$7\frac{1}{2}$	$7\frac{29}{32}$	$8\frac{3}{8}$	$8\frac{5}{8}$	$8\frac{7}{8}$
LAMB.							
	d.			*d.*			*d.*
1870 - -	$7\frac{1}{4}$	...	...	$8\frac{3}{4}$	...	...	$10\frac{1}{4}$
1871 - -	$9\frac{3}{4}$	...	...	$10\frac{11}{16}$	...	...	$11\frac{5}{8}$
1872 - -	$11\frac{1}{4}$	...	...	$12\frac{5}{16}$	...	...	$13\frac{3}{8}$
1873 - -	$11\frac{1}{8}$	...	...	$11\frac{7}{8}$	...	...	$12\frac{5}{8}$
1874 - -	$9\frac{3}{4}$	...	...	$10\frac{1}{2}$	...	...	$11\frac{1}{4}$

Note.—For the Prices of Meat at the Metropolitan Meat Market, see Table V.; at Liverpool, Table VI.; at Glasgow, Table VII.; at Vienna, Table LXI.; and in Germany, Tables LXII. to LXIX. inclusive.

For the *Number* of *Cattle*, *Sheep*, and *Swine* at the Metropolitan Cattle Market, see Table II.

* This column may be taken to represent the Mean Prices of each kind of Live Meat per lb., sinking the Offal.

TABLE IV.

TABLE showing the QUANTITY of DEAD **MEAT** delivered at the METROPOLITAN MEAT MARKET, during each Quarter of the Years 1869, 1870, 1871, 1872, and 1873, distinguishing the Country Meat, from the Foreign and Town-Killed Meat.

(Compiled from Returns given in the Annual Reports to the Court of Common Council.)

DESCRIPTION OF MEAT.	YEARS.	QUANTITY DELIVERED at the MARKET.				
		1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	TOTAL for the YEAR.
		Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
COUNTRY MEAT - - -	1869	419,360	320,600	234,960	358,600	1,333,520
	1870	459,800	351,280	248,160	417,540	1,476,780
	1871	481,600	382,480	247,060	450,220	1,561,360
	1872	534,740	421,660	292,000	495,000	1,743,400
	1873	569,060	383,580	268,140	458,820	1,679,600
FOREIGN and TOWN-KILLED MEAT	1869	250,940	307,720	320,700	358,700	1,238,060
	1870	281,860	304,620	350,060	390,340	1,326,880
	1871	322,720	343,640	366,460	355,620	1,388,440
	1872	305,900	324,180	363,560	343,860	1,337,500
	1873	287,720	352,780	351,060	367,740	1,359,300
TOTAL - - -	1869	670,300	628,320	555,660	717,300	2,571,580
	1870	741,660	655,900	598,220	807,880	2,803,660
	1871	804,320	726,120	613,520	805,840	2,949,800
	1872	840,640	745,840	655,560	838,860	3,080,900
	1873	856,780	736,360	619,200	826,560	3,038,900

For the *Prices* of Beef and Mutton at the Metropolitan Meat Market, see Table V.

TABLE V.

AVERAGE WHOLESALE PRICES of **BEEF** and **MUTTON** per lb., by the Carcase, at the METROPOLITAN MEAT MARKET, for each Quarter of the Years 1870, 1871, 1872, 1873, and 1874.

(Compiled from the Quarterly Returns of the Registrar-General.)

YEARS.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	AVERAGE PRICES for the YEAR.
BEEF.					
	d.	*d.*	*d.*	*d.*	*d.*
1870 - - -	$5\frac{3}{4}$	$5\frac{5}{8}$	6	$6\frac{3}{8}$	$5\frac{30}{32}$
1871 - - -	$6\frac{3}{8}$	$6\frac{1}{2}$	$6\frac{3}{4}$	$6\frac{1}{2}$	$6\frac{17}{32}$
1872 - - -	$6\frac{1}{8}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{3}{4}$	$6\frac{15}{32}$
1873 - - -	$6\frac{3}{4}$	$7\frac{3}{8}$	$7\frac{1}{4}$	$6\frac{3}{4}$	$7\frac{1}{32}$
1874 - - -	$6\frac{3}{4}$	$6\frac{1}{2}$	$7\frac{7}{8}$	$6\frac{1}{2}$	$6\frac{29}{32}$
MUTTON.					
	d.	*d.*	*d.*	*d.*	*d.*
1870 - - -	$6\frac{1}{4}$	$6\frac{3}{8}$	$6\frac{5}{8}$	$6\frac{5}{8}$	$6\frac{15}{32}$
1871 - - -	$6\frac{1}{2}$	7	$7\frac{1}{2}$	$6\frac{3}{4}$	$6\frac{30}{32}$
1872 - - -	$7\frac{1}{8}$	$7\frac{3}{8}$	$7\frac{3}{4}$	$7\frac{1}{4}$	$7\frac{12}{32}$
1873 - - -	$7\frac{5}{8}$	$8\frac{1}{8}$	$7\frac{7}{8}$	$7\frac{1}{8}$	$7\frac{22}{32}$
1874 - - -	$6\frac{7}{8}$	$6\frac{5}{8}$	$7\frac{1}{2}$	$6\frac{1}{4}$	$6\frac{26}{32}$

For the *Quantity* of Meat delivered at the Metropolitan Meat Market, see Table IV. For the *Prices* of Meat at the Metropolitan Cattle Market, sinking the Offal, see Table III.; at Liverpool, Table VI.; at Glasgow, Table VII.; at Vienna, Table LXI.; and in Germany, Tables LXII. to LXIX. inclusive.

TABLE VI.

LOWEST and HIGHEST PRICES of **BEEF** and **MUTTON** per lb., by the Carcase, at the ABATTOIR COMPANY'S SLAUGHTER-HOUSES, LIVERPOOL, for each Quarter of the Years 1870, 1871, 1872, 1873, and 1874.

(*Furnished by Dr. Trench, Medical Officer of Health, Liverpool.*)

YEARS.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	AVERAGE PRICES for the YEAR.
			BEEF.		
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*
1870 - -	4½ to 6½	5 to 7	5 to 6¾	5 to 7	4⅞ to $6\frac{13}{16}$
1871 - -	5¼ „ 7	5½ „ 7½	5½ „ 7¼	5 „ 6¾	$5\frac{5}{16}$ „ 7⅛
1872 - -	5 „ 7	5½ „ 7½	6 „ 7¾	5 „ 7¼	5⅜ „ 7⅜
1873 - -	5¾ „ 7¾	7 „ 9	7 „ 9	5 „ 7¾	$6\frac{3}{16}$ „ 8⅜
1874 - -	4½ „ 8	5 „ 8½	5½ „ 8¼	4½ „ 8	4⅞ „ $8\frac{13}{16}$
			MUTTON.		
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*
1870 - -	5¼ to 7¾	6 to 8	5½ to 7½	5 to 7¼	$5\frac{7}{16}$ to 7⅝
1871 - -	5¾ „ 7¾	7 „ 8½	6½ „ 8¼	5½ „ 7½	$6\frac{3}{16}$ „ 8
1872 - -	7 „ 8¼	7 „ 8¾	7½ „ 9	7 „ 8¼	7⅛ „ $8\frac{9}{16}$
1873 - -	6¾ „ 9	8 „ 9½	7 „ 9¼	5½ „ 8	$6\frac{13}{16}$ „ $8\frac{15}{16}$
1874 - -	6½ „ 8½	7 „ 8½	6 „ 8	5 „ 8	6⅛ „ 8¼

Note.—For the Prices of Meat at the Metropolitan Cattle Market, see Table III.; at the Metropolitan Meat Market, Table V. at Glasgow, Table VII.; at Vienna, Table LXI.; and in Germany, Tables LXII. to LXIX. inclusive.

TABLE VII.

AVERAGE LOWEST and HIGHEST WHOLESALE PRICES of **BEEF** and **MUTTON** per lb., by the Carcase, at GLASGOW, for each Quarter of the Years 1870, 1871, 1872, 1873, and 1874.

(*Furnished by Professor McCall, Principal of the Veterinary College, Glasgow.*)

YEARS.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	AVERAGE PRICES for the YEAR.
			BEEF.		
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*
1870 - -	6¼ to 7¼	6¼ to 7½	6½ to 8	6¼ to 7½	$6\frac{5}{16}$ to $7\frac{9}{16}$
1871 - -	6 „ 7	6 „ 7¼	7¼ „ 8¼	6¼ „ 7¼	6⅜ „ $7\frac{7}{16}$
1872 - -	6¼ „ 7¼	6¼ „ 7¼	6½ „ 7½	6½ „ 7½	6⅜ „ 7⅜
1873 - -	6½ „ 7½	7 „ 8	8½ „ 9	7 „ 8¼	7¼ „ $8\frac{3}{16}$
1874 - -	6¾ „ 7¾	7 „ 8	7 „ 8	6¾ „ 7¾	6⅞ „ 7⅞
			MUTTON.		
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*
1870 - -	6 to 7	7¼ to 8¼	7½ to 8½	6 to 7	$6\frac{11}{16}$ to $7\frac{11}{16}$
1871 - -	6 „ 7½	7 „ 8½	7 „ 8½	6 „ 7½	6½ „ 8
1872 - -	6 „ 7	7½ „ 8½	7 „ 8	6½ „ 7½	6¾ „ 7¾
1873 - -	7 „ 8	8 „ 9½	7 „ 8	6½ „ 7½	7⅛ „ 8¼
1874 - -	6½ „ 7½	7 „ 8	7½ „ 8½	6½ „ 7½	6⅞ „ 7⅞

Note.—For the Prices of Meat at the Metropolitan Cattle Market, see Table III.; at the Metropolitan Meat Market, Table V.; at Liverpool, Table VI.; at Vienna, Table LXI.; and in Germany, Tables LXII. to LXIX. inclusive.

TABLE VIII.

TABLE showing the RESULTS of **CONTAGIOUS OR INFECTIOUS DISEASES** in GREAT BRITAIN during the Years 1870, 1871, 1872, 1873, and 1874; compiled from the Weekly Returns received from the Inspectors of the Local Authorities; and corrected (with the exception of the Returns of Foot-and-Mouth Disease and Sheep-Scab) in accordance with subsequent correspondence.

DISEASE.	DESCRIPTION of Animals.	YEARS.	Number of COUNTIES reported from.	Number of FARMS or OTHER PLACES upon which FRESH OUTBREAKS took place.	HEALTHY ANIMALS on infected Premises.		ATTACKED.		DISEASED ANIMALS.			
					SLAUGHTERED.	REMOVED.	REMAINING diseased from the previous Year.	ATTACKED in each Year.*	KILLED.†	DIED.†	RECOVERED.†	REMAINING diseased at the end of each Year.
CATTLE PLAGUE	Cattle	1870	...	...	...	...	...	...	...	...	...	...
		1871	...	...	...	...	...	...	...	...	...	...
		1872	1	23	171	††1	...	72	51	21	...	...
		1873	...	...	...	...	...	...	...	...	...	...
		1874	...	...	...	...	...	...	...	...	...	...
PLEURO-PNEUMONIA	Cattle	1870‡	68	1,508	638	1,397	197	4,602	1,755	1,276	1,635	133
		1871	68	1,669	549	1,287	133	5,869	2,207	1,339	2,332	124
		1872	71	2,474	983	2,262	124	7,983	3,871	1,979	2,017	240
		1873§	72	2,711	1,017	1,013	240	6,787	§5,061	1,028	904	34
		1874‖	71	3,262	655	830	34	7,740	7,434	289	31	20
FOOT-AND-MOUTH	Cattle, Sheep, Swine, and other Animals.	1870‡	84	27,254	—	—	—	‡‡457,697	990	5,583	415,900	—
		1871	92	52,164	—	—	—	§§691,565	2,051	5,853	633,084	—
		1872¶	—	—	—	—	—	—	—	—	—	—
		1873¶	—	—	—	—	—	—	—	—	—	—
		1874¶	—	—	—	—	—	—	—	—	—	—
SHEEP-SCAB	Sheep	1870‡	65	2,573	198	4,102	—	76,718	1,192	735	46,736	—
		1871	65	2,412	584	2,089	—	58,089	385	779	39,638	—
		1872	72	2,183	111	1,557	—	60,354	423	276	46,270	—
		1873	63	1,487	243	1,844	—	41,104	627	405	34,749	—
		1874‖	62	1,418	368	1,544	—	44,489	379	324	31,980	—
GLANDERS	Horses	1870‡	29	170	5	11	17	234	208	14	5	24
		1871	31	154	2	1	24	204	203	10	5	10
		1872	36	265	1	290	10	325	300	12	10	13
		1873	36	323	4	4	13	436	393	26	5	25
		1874‖	42	401	3	1	25	507	477	24	19	12
FARCY	Horses	1870**	—	—	—	—	—	—	—	—	—	—
		1871**	—	—	—	—	—	—	—	—	—	—
		1872**	—	—	—	—	—	—	—	—	—	—
		1873**	17	49	...	2	...	55	33	2	17	3
		1874‖	21	121	...	1	3	129	97	11	21	3

Note.—For the Results of each Disease in the Year 1874, *in each County of Great Britain*, see Table XIII. for Pleuro-Pneumonia; Table XX. for Sheep-Scab; Table XXII. for Glanders; and Table XXVII. for Farcy.

* For the *Proportion per Cent.* which the Number of Animals *Attacked* by Cattle Plague, Pleuro-Pneumonia, Sheep-Scab, Glanders, and Farcy, in each of the above Years, bears to the Total Number of Animals in England, in Wales, in Scotland, and in Great Britain respectively, see Table IX.

† For the *Proportion per Cent.* of the Number of Diseased Animals *Killed, Died,* and *Recovered* in Great Britain, in each of the above Years, see Table X.

‡ There were 53 Saturdays in the Year 1870. The Numbers given for that Year, consequently include the results for 53 Weeks.

§ By an Order of Council which came into operation on the 1st September 1873, the slaughter of Cattle affected with Pleuro-Pneumonia was made compulsory.

‖ For the Number of Animals Attacked by each Disease, in *each Week* of the Year 1874, in England, Wales, Scotland, and Great Britain respectively, see Table XII.

¶ No record exists of the results of Foot-and-Mouth Disease in the Years 1872, 1873, and 1874.

** By an Order of Council which came into operation on the 3d July 1873, Farcy was declared to be a contagious disease for the purposes of The Contagious Diseases (Animals) Act, 1869. There is no record of the results of the Disease in the Years 1870, 1871, and 1872, or the first Half-Year of 1873. The Numbers quoted for Farcy for the Year 1873, are consequently for Six Months only.

†† This Animal died from Rupture.

‡‡ This Number consists of 379,395 Cattle, 39,714 Sheep, 38,407 Swine, 47 Goats, 133 Horses, and 1 other Animal.

TABLE IX.

NUMBER of CATTLE, SHEEP, and HORSES, in ENGLAND, in WALES, in SCOTLAND, and in GREAT BRITAIN respectively; Number reported to have been **ATTACKED** with any **CONTAGIOUS** or **INFECTIOUS DISEASE** (EXCEPTING FOOT-AND-MOUTH DISEASE—*See Note**); and the **PROPORTIONS PER CENT.** which the Numbers of DISEASED Animals bear to the TOTAL Number of the same Class of Animal Enumerated, during the Years 1870, 1871, 1872, 1873, and 1874.

—	YEARS.	NUMBER of ANIMALS ENUMERATED.†			DISEASED ANIMALS.														
					CATTLE PLAGUE.		PLEURO-PNEUMONIA.		SHEEP-SCAB.		GLANDERS.		FARCY.§		ALL DISEASES (excepting Foot-and-Mouth Disease).				
		Cattle.	Sheep.	Horses.‡	Cattle.		Cattle.		Sheep.		Horses.		Horses.		Cattle.		Sheep.		Horses.	
					Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
ENGLAND	1870	3,757,134	18,940,256	—	...	...	3,038	·0808	68,583	·3621	200	—	—	—	3,038	·0808	68,583	·3621	200	—
	1871	3,671,064	17,530,407	—	...	...	3,558	·0969	44,668	·2548	169	—	—	—	3,558	·0969	44,668	·2548	169	—
	1872	3,901,663	17,912,904	—	72	·0018	6,185	·1585	53,321	·2977	303	—	—	—	6,257	·1603	53,321	·2977	303	—
	1873	4,173,635	19,169,851	—	...	...	5,187	·1243	35,974	·1877	379	—	§43	—	5,187	·1243	35,974	·1877	422	—
	1874	4,305,540	19,859,758	—	...	...	5,602	·1301	39,417	·1985	452	—	121	—	5,602	·1301	39,417	·1985	573	—
WALES	1870	604,749	2,706,479	—	...	...	78	·0129	7,703	·2846	30	—	—	—	78	·0129	7,703	·2846	30	—
	1871	596,588	2,706,415	—	...	...	14	·0023	13,094	·4838	15	—	—	—	14	·0023	13,094	·4838	15	—
	1872	602,738	2,867,144	—	...	...	40	·0066	5,897	·2057	19	—	—	—	40	·0066	5,897	·2057	19	—
	1873	642,857	2,966,862	—	...	...	16	·0025	3,880	·1308	8	—	§7	—	16	·0025	3,880	·1308	15	—
	1874	665,105	3,064,696	—	...	...	...	...	2,707	·0883	2	—	...	—	...	...	2,707	·0883	2	—
SCOTLAND	1870	1,041,434	6,750,854	—	...	...	1,486	·1427	432	·0064	4	—	—	—	1,486	·1427	432	·0064	4	—
	1871	1,070,107	6,882,747	—	...	...	2,297	·2147	327	·0048	20	—	—	—	2,297	·2147	327	·0048	20	—
	1872	1,120,593	7,141,459	—	...	...	1,758	·1569	1,136	·0159	3	—	—	—	1,758	·1569	1,136	·0159	3	—
	1873	1,148,057	7,290,922	—	...	...	1,584	·1380	1,250	·0171	49	—	§5	—	1,584	·1380	1,250	·0171	54	—
	1874	1,154,846	7,389,487	—	...	...	2,138	·1851	2,365	·0320	53	—	8	—	2,138	·1851	2,365	·0320	61	—
GREAT BRITAIN	1870	5,403,317	28,397,589	2,180,824	...	...	4,602	·0852	76,718	·2702	234	·0107	—	—	4,602	·0852	76,718	·2702	234	·0107
	1871	5,337,759	27,119,569	2,168,565	...	...	5,869	·1099	58,089	·2142	204	·0094	—	—	5,869	·1099	58,089	·2142	204	·0094
	1872	5,624,994	27,921,507	2,165,068	72	·0013	7,983	·1419	60,354	·2162	325	·0150	—	—	8,055	·1432	60,354	·2162	325	·0150
	1873	5,964,549	29,427,635	2,191,444	...	...	6,787	·1138	41,104	·1397	436	·0199	§55	·0025	6,787	·1138	41,104	·1397	491	·0224
	1874	6,125,491	30,313,941	2,226,739	...	...	7,740	·1264	44,489	·1468	507	·0228	129	·0058	7,740	·1264	44,489	·1468	636	·0286

Note.—For the Proportion per Cent. of the Number of Diseased Animals *Killed*, *Died*, and *Recovered* in each of the above Years, in Great Britain, see Table X.; and for the Proportion in the Year 1874, in England, in Wales, in Scotland, and in Great Britain respectively, see Table XI.

* Returns of Foot-and-Mouth Disease are not now required by the Lords of the Council.

† The Numbers of Animals Enumerated are compiled from the "Agricultural Returns" published by the Board of Trade. See also Table I.

‡ The Number of Horses has been increased by adding to the Number Enumerated, an estimated Number of Horses not used in Agriculture, and therefore not figuring in the "Agricultural Returns." This information cannot be separately given for England, Wales, and Scotland.

§ See Note ** to Table VIII.

TABLE X.

Number of Diseased Animals **KILLED, DIED,** and **RECOVERED** in Great Britain, in each of the Years 1870, 1871, 1872, 1873, and 1874; and the **PROPORTIONS PER CENT.** which such Numbers bear to the Total Number of Animals affected with each Disease.

Disease.	Years.	Number.			Proportion per Cent.		
		Killed.	Died.	Recovered.	Killed.	Died.	Recovered.
Cattle Plague	1870	...	...	...	...	...	...
	1871	...	...	...	...	...	...
	1872	51	21	...	70·833	29·167	...
	1873	...	...	...	...	...	...
	1874	...	...	...	...	...	...
Pleuro-Pneumonia	1870	1,755	1,276	1,635	37·612	27·347	35·041
	1871	2,207	1,339	2,332	37·547	22·780	39·673
	1872	3,871	1,979	2,017	49·205	25·156	25·639
	1873*	*5,061	1,028	904	*72·372	14·701	12·927
	1874	7,434	289	31	95·873	3·727	·400
Foot-and-Mouth	1870	990	5,583	415,900	·234	1·322	98·444
	1871	2,051	5,853	633,084	·320	·913	98·767
	1872†	—	—	—	—	—	—
	1873†	—	—	—	—	—	—
	1874†	—	—	—	—	—	—
Sheep-Scab	1870	1,192	735	46,736	2·450	1·510	96·040
	1871	385	779	39,638	·944	1·909	97·147
	1872	423	276	46,270	·900	·588	98·512
	1873	627	405	34,749	1·752	1·132	97·116
	1874	379	324	31,980	1·160	·991	97·849
Glanders	1870	208	14	5	91·630	6·167	2·203
	1871	203	10	5	93·119	4·587	2·294
	1872	300	12	10	93·168	3·727	3·105
	1873	393	26	5	92·689	6·132	1·179
	1874	477	24	19	91·731	4·615	3·654
Farcy	1870‡	—	—	—	—	—	—
	1871‡	—	—	—	—	—	—
	1872‡	—	—	—	—	—	—
	1873§	33	2	17	63·462	3·846	32·692
	1874	97	11	21	75·194	8·527	16·279

Note.—For the Proportion per Cent. of the Number of Animals *Attacked* by each Disease in each of the above Years, see Table IX. For the Per-Centages of the Numbers Killed, Died, and Recovered, in the Year 1874, in England, in Wales, in Scotland, and in Great Britain respectively, see Table XI.

* See Note § to Table VIII.

† No record exists of the cases of Foot-and-Mouth Disease in the Years 1872, 1873, and 1874.

‡ No record exists of the cases of Farcy in the Years 1870, 1871, 1872, and the first Half Year of 1873; see Note ** to Table VIII.

§ The Numbers quoted for Farcy for the Year 1873 are for Six Months only; see Note ‡.

TABLE XI.

Number of Diseased Animals **KILLED, DIED,** and **RECOVERED** in England, in Wales, in Scotland, and in Great Britain respectively, in the Year 1874; and the **PROPORTIONS PER CENT.** which such Numbers bear to the Total Number of Animals affected with each Disease.

Disease.	—	Number.			Proportion per Cent.		
		Killed.	Died.	Recovered.	Killed.	Died.	Recovered.
Pleuro-Pneumonia	England	5,343	241	24	95·275	4·297	·428
	Wales	...	...	...	...	...	...
	Scotland	2,091	48	7	97·437	2·237	·326
	Great Britain	7,434	289	31	95·873	3·727	·400
Sheep-Scab	England	318	271	27,260	1·142	·973	97·885
	Wales	23	30	2,581	·873	1·139	97·988
	Scotland	38	23	2,139	1·727	1·046	97·227
	Great Britain	379	324	31,980	1·160	·991	97·849
Glanders	England	428	21	17	91·846	4·506	3·648
	Wales	1	1	...	50·000	50·000	...
	Scotland	48	2	2	92·308	3·846	3·846
	Great Britain	477	24	19	91·731	4·615	3·654
Farcy	England	90	11	20	74·380	9·091	16·529
	Wales	...	...	...	...	...	...
	Scotland	7	...	1	87·500	...	12·500
	Great Britain	97	11	21	75·194	8·527	16·279

Note.—For the Proportion per Cent. of the Number of Animals *Attacked* by each Disease, see Table IX. For the Per-Centages of the Numbers Killed, Died, and Recovered in Great Britain, in the Years 1870, 1871, 1872, 1873, and 1874, see Table X.

TABLE XII.

E showing the NUMBER of ANIMALS reported, by the Inspectors of the Local Authorities, to have been **ATTACKED** with PLEURO-PNEUMONIA, SHEEP-SCAB, GLANDERS, and FARCY, in ENGLAND, in WALES, in SCOTLAND, nd in GREAT BRITAIN, during each WEEK of the Year 1874.

EEKS DING	PLEURO-PNEUMONIA.				SHEEP-SCAB.				GLANDERS.				FARCY.			
	England.	Wales.	Scotland.	GREAT BRITAIN	England.	Wales.	Scotland.	GREAT BRITAIN	England.	Wales.	Scotland.	GREAT BRITAIN	England.	Wales.	Scotland.	GREAT BRITAIN.
y 3	126	...	36	162	2,387	84	7	2,478	6	...	4	10	2	...	...	2
10	121	...	40	161	842	98	...	940	10	...	2	12	7	...	...	7
17	109	...	47	156	1,729	74	...	1,803	7	1	2	10	...	...	...	...
24	83	...	38	121	2,972	69	17	3,058	4	...	...	4	3	...	...	3
31	108	...	35	143	1,494	201	88	1,783	5	...	1	6	6	...	...	6
ry 7	103	...	32	135	1,078	153	66	1,297	2	...	4	6	1	...	...	1
14	119	...	35	154	564	208	65	837	8	...	...	8	1	...	...	1
21	96	...	36	132	891	84	29	1,004	6	...	5	11	4	...	...	4
28	82	...	31	113	412	44	47	503	8	...	...	8	2	...	...	2
7	95	...	40	135	788	36	5	829	8	...	...	8	...	...	...	...
14	110	...	25	135	570	108	...	678	10	...	5	15	2	...	...	2
21	111	...	31	142	409	30	3	442	18	...	1	19	...	...	...	...
28	103	...	16	119	440	5	...	445	11	...	1	12	...	...	...	...
4	105	...	40	145	321	69	...	390	4	...	2	6	1	...	...	1
11	93	...	23	116	28	32	...	60	4	...	2	6	...	...	...	...
18	116	...	38	154	85	10	...	95	18	...	...	18	4	...	...	4
25	89	...	26	115	533	1	93	627	11	...	1	12	1	...	...	1
2	116	...	46	162	267	133	236	636	4	...	...	4	...	...	...	...
9	73	...	47	120	23	15	...	38	2	...	...	2	3	...	...	3
16	109	...	24	133	99	...	...	99	4	...	1	5	2	...	...	2
23	134	...	41	175	82	...	...	82	6	...	2	8	2	...	1	3
30	142	...	37	179	84	5	126	215	8	...	1	9	2	...	...	2
6	132	...	54	186	233	57	134	424	9	...	...	9	...	...	...	...
13	115	...	72	187	117	77	50	244	6	...	2	8	...	...	...	...
20	151	...	74	225	283	...	41	324	9	...	1	10	6	...	...	6
27	157	...	95	252	969	5	...	974	13	...	...	13	1	...	...	1
4	138	...	54	192	11	5	37	53	5	...	...	5	3	...	...	3
11	135	...	38	173	169	...	125	294	9	...	...	9	1	...	...	1
18	144	...	57	201	780	...	50	830	11	...	...	11	5	...	...	5
25	125	...	82	207	76	...	3	79	9	...	...	9	1	...	1	2
t 1	128	...	59	187	202	...	15	217	14	...	...	14	1	...	...	1
8	114	...	52	166	834	...	...	834	14	...	...	14	2	...	...	2
15	104	...	89	193	215	...	...	215	11	1	2	14	2	...	1	3
22	93	...	63	156	737	5	44	786	8	...	1	9	3	...	1	4
29	142	...	52	194	859	...	13	872	11	...	...	11	4	...	...	4
nber 5	131	...	47	178	274	11	104	389	5	...	2	7	3	...	...	3
12	166	...	44	210	458	5	11	474	12	...	...	12	4	...	...	4
19	135	...	32	167	1,481	...	34	1,515	9	...	...	9	4	...	...	4
26	138	...	40	178	796	...	...	796	6	...	...	6	4	...	...	4
r 3	108	...	35	143	854	72	228	1,154	9	...	...	9	1	...	1	2
10	84	...	42	126	1,341	7	96	1,444	5	...	...	5	5	...	1	6
17	111	...	47	158	327	26	40	393	16	...	2	18	3	...	...	3
24	92	...	36	128	598	75	72	745	3	...	...	3	1	...	...	1
31	81	...	23	104	897	76	128	1,101	12	...	1	13	1	...	...	1
nber 7	80	...	19	99	1,376	4	191	1,571	12	...	2	14	4	...	1	5
14	61	...	33	94	742	72	51	865	12	...	4	16	3	...	...	3
21	85	...	19	104	2,112	90	7	2,209	11	...	1	12	3	...	1	4
28	53	...	30	83	590	77	26	693	8	...	...	8	2	...	...	2
ber 5	73	...	19	92	1,075	382	21	1,478	8	...	1	9	6	...	...	6
12	67	...	25	92	2,677	84	9	2,770	7	...	...	7	1	...	...	1
19	55	...	23	78	1,065	55	36	1,156	12	...	...	12	1	...	...	1
26	61	...	19	80	1,171	63	17	1,251	12	...	...	12	3	...	...	3
AL * -	5,602	...	2,138	7,740	39,417	2,707	2,365	44,489	452	2	53	507	121	...	8	129

ote.—For the Number of Animals Attacked in *each County*, in each Week, see Table XIV. for Pleuro-Pneumonia; Table XXI. for Sheep-Scab; Table XXIII. for Glanders; and Table XXVIII. for Farcy.

For the detailed *Weekly Progress* of disease in Great Britain, see Table XVIII. for Pleuro-Pneumonia; Table XIX. for Sheep-Scab; Table XXV. for Glanders; and Table XXVI. for Farcy.

For the *Aggregate Results* in each County, and in England, Wales, Scotland, and Great Britain, see Table XIII. for Pleuro-Pneumonia; Table XX. for Sheep-Scab; Table XXII. for Glanders; and Table XXVII. for Farcy.

For the *Aggregate Results* of each Disease in Great Britain, in each of the Years 1870, 1871, 1872, 1873, and 1874, see Table VIII.

For the *Proportion per Cent.* which the Number of Animals Attacked with each disease bears to the Total Number of Animals in Great Britain, see e IX.

TABLE

NUMBER of FARMS or other PLACES in the COUNTIES of GREAT BRITAIN upon which Fresh Outbreaks of
during the Year 1874; with the Number of Cattle reported to have been

COUNTIES, &c.	Number of Counties reported from.	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Cattle on infected Premises.		Attacked.		Diseased Cattle.			
					Slaughtered	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
GREAT BRITAIN*	71	174	3,262	3,436	655	830	34	†7,740	†7,434	289	31	20
ENGLAND *	46	139	2,730	2,869	396	520	26	5,602	5,343	241	24	20
WALES *	...	...	...	...	...	...	...	...	...	...	...	...
SCOTLAND *	25	35	532	567	259	310	8	2,138	2,091	48	7	...
ENGLAND.												
Bedford		...	6	6	...	...	...	8	6	...	...	2
Berks		1	14	15	...	...	...	42	33	8	1	...
Buckingham		5	27	32	...	21	...	59	57	2	...	...
Cambridge (ex. Liberty of I. of Ely)		1	46	47	3	...	...	80	79	1	...	...
Chester		2	46	48	30	2	2	99	93	7	1	...
Cornwall		...	8	8	...	...	...	21	16	...	2	3
Cumberland		2	32	34	2	3	...	61	57	4	...	...
Derby		4	31	35	13	17	...	112	106	6	...	...
Devon		...	3	3	2	...	...	12	12	...	...	...
Dorset		...	3	3	1	1	...	5	5	...	...	...
Durham		...	14	14	...	...	...	29	25	3	1	...
Essex		7	155	162	7	53	...	321	304	15	...	2
Gloucester		...	1	1	...	...	...	1	...	1	...	...
Hants		5	27	32	26	5	4	106	103	6	1	...
Hereford		...	1	1	...	3	...	22	18	2	2	...
Hertford (ex. Liberty of St. Albans)		2	41	43	4	...	...	138	132	6	...	...
Huntingdon		...	71	71	1	1	...	93	86	7	...	...
Kent (ex. Metropolis)		1	92	93	3	5	...	156	147	9	...	...
Lancaster		9	120	129	32	19	...	267	255	9	1	2
Leicester		4	93	97	12	14	...	192	183	6	3	...
Lincoln, Parts of Holland		1	11	12	...	...	...	15	15	...	...	...
,, ,, Kesteven		...	5	5	...	...	...	5	5	...	...	...
,, ,, Lindsey		2	11	13	2	12	...	19	19	...	...	...
Middlesex (ex. Metropolis)		13	46	59	26	...	1	121	115	7	...	...
Monmouth		...	...	...	...	...	...	...	...	...	...	...
Norfolk		20	458	478	17	47	1	1042	1018	23	...	2
Northampton (ex. Soke of Peterbro')		4	91	95	...	20	2	150	143	8	...	1
Northumberland		1	46	47	1	15	...	82	68	11	1	2
Notts		2	28	30	...	27	...	52	45	4	1	2
Oxford		1	16	17	...	5	...	33	31	2	...	...
Rutland		...	2	2	...	...	...	3	2	1	...	...
Salop		1	22	23	54	54	...	55	52	3	...	...
Somerset		1	9	10	12	16	4	39	41	2	...	...
Stafford		1	128	129	3	28	1	187	183	5	...	...
Suffolk		23	137	160	25	28	6	349	333	14	7	1
Surrey (ex. Metropolis)		5	50	55	58	1	...	142	128	14	...	...
Sussex		1	56	57	8	2	...	107	91	13	3	...
Warwick		2	53	55	2	...	...	84	83	1	...	...
Westmorland		...	...	...	...	...	...	...	...	...	...	...
Wilts		2	6	8	4	...	...	26	26	...	...	...
Worcester		...	28	28	6	22	...	60	59	1	...	...
York, East Riding		...	54	54	...	3	...	109	108	1	...	...
,, North ,,		1	95	96	6	22	...	160	150	8	...	2
,, West ,,		3	339	342	12	45	...	492	466	26	...	...

Note.—For the *Weekly Progress* of the Disease in Great Britain, see Table XVIII.; and for the Numbers Attacked,

* For the *Results* of the Disease in Great Britain in *each of the Years 1870, 1871, 1872, 1873, and 1874*, see Table VIII. For the *Proportion* in each Year, see Table IX.; and for the Proportion per Cent. of the Number of Diseased Cattle Killed, Died, and Recovered respectively, Great Britain respectively, see Table XII.; and for the *Proportion per Cent.* of the Number of Diseased Cattle Killed, Died, and

† In addition to the above, 2 Foreign Cattle were imported, which were affected

XIII.

PLEURO-PNEUMONIA were reported, by the Inspectors of the Local Authorities, to have occurred, Attacked, to have been Killed, to have Died, and to have Recovered.

COUNTIES (*continued.*)	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Cattle on infected Premises.		Attacked.		Diseased Cattle.			
				Slaughtered	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
ENGLAND—*cont.*											
Liberty of the Isle of Ely	6	41	47	1	21	3	66	68	1	...	...
Soke of Peterborough	...	4	4	...	...	...	4	4	...	...	...
Liberty of St. Albans	2	14	16	...	...	...	36	34	2	...	...
The Metropolis	4	149	153	23	8	2	340	339	2	...	1
WALES.											
Anglesey	...	...	...	...	...	...	...	...	...	...	...
Brecon	...	...	...	...	...	...	...	...	...	...	...
Cardigan	...	...	...	...	...	...	...	...	...	...	...
Carmarthen	...	...	...	...	...	...	...	...	...	...	...
Carnarvon	...	...	...	...	...	...	...	...	...	...	...
Denbigh	...	...	...	...	...	...	...	...	...	...	...
Flint	...	...	...	...	...	...	...	...	...	...	...
Glamorgan	...	...	...	...	...	...	...	...	...	...	...
Merioneth	...	...	...	...	...	...	...	...	...	...	...
Montgomery	...	...	...	...	...	...	...	...	...	...	...
Pembroke	...	...	...	...	...	...	...	...	...	...	...
Radnor	...	...	...	...	...	...	...	...	...	...	...
SCOTLAND.											
Aberdeen	5	44	49	40	12	4	291	289	6	...	...
Argyll	1	3	4	1	...	...	9	9	...	...	...
Ayr	2	...	2	...	...	...	1	1	...	...	...
Banff	...	24	24	15	2	...	54	50	4	...	...
Berwick	...	8	8	...	7	...	10	10	...	...	...
Bute	...	...	...	...	...	...	...	...	...	...	...
Caithness	...	...	...	...	...	...	...	...	...	...	...
Clackmannan	1	5	6	3	...	...	21	21	...	...	...
Cromarty	...	...	...	...	...	...	...	...	...	...	...
Dumbarton	...	3	3	...	...	...	18	17	1	...	...
Dumfries	...	...	...	...	...	...	...	...	...	...	...
Edinburgh	9	146	155	25	4	1	518	515	4	...	...
Elgin, or Moray	...	3	3	7	...	...	6	6	...	...	...
Fife	2	56	58	1	170	1	89	84	5	1	...
Forfar	3	98	101	14	73	2	349	346	2	3	...
Haddington	...	4	4	...	...	...	7	7	...	...	...
Inverness	2	1	3	2	...	...	2	1	1	...	...
Kincardine	...	13	13	7	...	...	72	70	2	...	...
Kinross	...	3	3	...	25	...	8	7	1	...	...
Kirkcudbright	...	2	2	6	...	...	16	16	...	...	...
Lanark	4	55	59	3	8	...	358	353	3	2	...
Linlithgow	...	11	11	14	...	...	24	22	2	...	...
Nairn	...	...	...	...	...	...	...	...	...	...	...
Orkney	...	...	...	...	...	...	...	...	...	...	...
Peebles	...	...	...	...	...	...	...	...	...	...	...
Perth	5	20	25	60	7	...	113	105	8	...	...
Renfrew	1	17	18	...	...	...	48	48	...	...	...
Ross	...	7	7	57	1	...	54	46	7	1	...
Roxburgh	...	2	2	...	...	...	2	2	...	...	...
Selkirk	...	...	...	...	...	...	...	...	...	...	...
Shetland	...	...	...	...	...	...	...	...	...	...	...
Stirling	...	5	5	...	...	...	5	5	...	...	...
Sutherland	...	1	1	4	1	...	24	23	1	...	...
Wigtown	...	1	1	...	...	...	39	38	1	...	...

Killed, Died, and Slaughtered Healthy, in each County, in *each Week*, see Tables XIV. to XVII. respectively.
per Cent. which the Numbers Attacked bear to the Total Number of Cattle in England, in Wales, in Scotland, and in Great Britain respectively, in each Year, see Table X. For the Numbers of Animals *Attacked* in *each Week* of the Year 1874, in England, in Wales, in Scotland, and in Recovered respectively, in the Year 1874, see Table XI.
with Pleuro-Pneumonia. They were slaughtered at the place of landing.

TABLE

TABLE showing the Number of CATTLE reported, by the Inspectors of the Local Authorities, to have been
of the Year

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.*																										
Bedford	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.
Berks	.	1	.	.	.	.	1	1	.	.	7	3	.	10	.	7	.	.	.	.	.	1	.	.	1	.
Buckingham	1	.	7	.	1	2	.	.	.	.	.	.	.	.	.	.	.	1	2	2	4	2	1	1	2	1
Cambridge (ex. Liberty of Isle of Ely)	6	3	6	3	8	6	4	.	.	1	1	1	2	2	1	3	1	1	3	2	1	3	1	1	4	1
Chester	2	.	.	3	13	.	5	5	.	4	6	2	.	2	2	1	3	5	.	2	.	1	2	2	1	6
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Cumberland	1	.	.	.	2	.	.	3	1	6	2	3	4	.	.	1	.	1	3	1	.	.	.	2	1	1
Derby	4	4	5	1	.	2	2	.	.	.	1	3	1	1	3	1	4	.	2	6	11	3	4	5	1	8
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	4	1	.
Dorset	.	.	.	.	.	2	.	.	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	1	.	3	2	1
Essex	10	4	9	6	2	10	3	6	3	10	5	6	2	6	6	4	1	5	3	5	8	5	4	4	8	5
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Hants	8	3	4	6	6	3	2	2	3	1	3	3	6	.	2	3	.	8	.	3	3	2	2	2	2	4
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	.	.	1	4
Hertford (ex. Liberty of St. Albans)	5	8	.	1	3	4	1	.	3	1	2	1	3	4	3	6	4	.	.	1	1	.	3	1	1	1
Huntingdon	4	4	.	2	2	3	4	2	5	.	1	3	2	.	1	2	1	1	1	2	2	2	.	2	3	1
Kent (ex. Metropolis)	6	5	1	2	6	5	6	8	3	.	4	2	4	6	7	3	3	4	1	2	7	3	1	6	3	2
Lancaster	7	3	5	1	6	4	6	3	5	7	3	4	4	1	6	4	3	4	4	5	6	1	5	3	7	10
Leicester	2	1	2	1	2	1	1	1	4	1	2	2	2	6	1	4	7	4	3	7	5	13	4	4	9	13
Lincoln, Parts of Holland	2	1	.	.	.	.	.	.	.	1	.	1	.	2	.	.	2	1	.	.	.	2	.	.	.	.
" " Kesteven	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
" " Lindsey	1	1	.	1	.	.	.	1	1	1	1	1	2	.	.	.	.	.	2	.	2	.	1	.	.	.
Middlesex (ex. Metropolis)	2	4	4	9	2	2	5	2	2	2	11	5	1	.	.	1	.	6	1	.	1	.	.	2	3	2
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	17	23	25	18	22	24	35	16	14	12	18	21	16	16	12	12	17	19	7	9	22	14	26	15	33	31
Northampton (ex. Soke of Peterboro')	.	3	1	2	1	2	4	1	.	.	1	.	3	3	.	5	3	2	3	3	1	7	6	7	4	1
Northumberland	.	1	.	1	.	.	2	2	1	.	.	1	2	2	1	1	.	1	.	1	5	.	2	.	.	1
Notts	1	1	.	.	2	.	.	.	1	.	.	.	1	.	2	2	.	1	2	1	.	5	1	4	1	2
Oxford	1	2	.	1	1	.	.	2	1	1	.	1	.	2	1	.	.	.	.	.	.	1	1	1	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	2	1	3	2	.	.	.	.	1	1	.	2	1	.	1	.	.	.	2	.	3	5	2	1	3	1
Somerset	.	4	.	.	2	3	3	2	2	1	.	2	1	3	7	1	.	.	2	.	1	2	.	.	.	.
Stafford	1	1	1	.	2	.	2	4	1	2	3	.	5	1	.	4	2	3	7	4	3	4	8	7	8	8
Suffolk	11	14	8	5	4	8	6	9	5	10	11	4	5	10	9	3	2	1	2	3	4	4	6	4	7	7
Surrey (ex. Metropolis)	5	4	4	5	2	6	4	2	1	2	1	1	1	5	3	.	5	3	1	.	11	2	1	1	1	2
Sussex	2	.	1	.	3	2	.	3	5	2	1	.	2	.	1	3	1	2	.	2	1	2	.	.	1	2
Warwick	1	1	.	2	1	2	1	1	5	4	.	1	1	3	1	4	4	3	.	3	2	3	1	.	4	1
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	3	.	4	.	.	.	2	.	.	.	1	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Worcester	2	.	.	.	.	.	.	.	1	3	2	1	2	.	.	3	.	1	.	3	.	1	.	3	.	2
York, East Riding	.	.	3	2	.	.	.	.	1	2	1	7	.	.	3	1	4	7	7	5	1	2	2	1	7	4
" North "	.	3	.	1	.	1	3	1	1	1	3	2	8	1	3	7	2	14	4	5	8	2	11	7	6	13
" West "	10	15	6	3	9	8	9	8	2	7	5	11	9	8	8	16	10	9	4	16	11	22	24	17	15	16
Liberty of the Isle of Ely	1	3	3	.	.	2	3	2	3	1	1	2	2	2	2	6	1	1	.	3	.	3	3	.	4	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Liberty of St. Albans	3	.	1	.	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	1	2	1	.	.	.	.
The Metropolis	3	3	6	3	6	1	5	9	7	8	12	11	10	7	6	6	8	6	6	12	8	9	8	5	6	6
WALES.*																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.*																										
Aberdeen	11	6	6	15	3	1	10	7	7	11	.	11	5	1	1	5	4	8	7	2	11	9	10	18	19	12
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	2	.	.	.
Ayr	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	.	.	.	.	1	.	2	.	3
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	1	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	1	.	.	1	.	.	.	2	.	.	.	.	.	.	1	1	3	2	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	12	4	13	7	4	12	9	12	10	8	.	7	.	3	4	2	1	5	3	1	5	8	12	17	16	17
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	1	.	1	.	.
Fife	2	1	3	3	4	2	.	1	1	.	2	2	2	3	.	3	1	4	1	2	2	2	.	1	8	7
Forfar	4	3	3	3	8	7	2	4	1	3	7	7	3	10	6	7	5	7	12	3	7	5	12	7	8	20
Haddington	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	3	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	1	.	1	1	1	2	.	.	.	.	.	.	2	6	.	5	4	3	2	2	4	.	2	14
Kinross	.	.	.	.	.	1	.	1	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
Lanark	5	24	21	9	8	5	13	9	10	16	10	1	5	19	1	6	8	11	4	3	4	4	1	11	3	2
Linlithgow	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	3	.	1	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	1	.	.	.	2	3	.	.	.	1	3	2	1	2	2	1	1	.	2	.	2	4	.	3	6	3
Renfrew	.	1	.	.	4	.	.	.	.	.	3	.	.	1	1	3	4	3	4	4	.	.	2	4	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	7	.	11	7	5	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Cattle Attacked with the Disease, in each County, during the Year,
* For the Number Attacked, in each Week, in England,

XIV.

ATTACKED with PLEURO-PNEUMONIA, in each County of Great Britain, during each Week 1874.

ENDING																										
July				August					September				October					November				December				Counties.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	Bedford.
2	1	.	.	.	.	.	.	5	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	Berks.
2	.	1	2	.	2	.	1	1	1	3	1	3	.	.	2	1	4	.	1	.	.	2	1	3	1	Buckingham.
.	1	.	.	2	1	.	1	.	.	.	.	2	.	1	2	.	.	.	1	1	.	2	.	.	1	Cambridge (ex. Liberty of Isle of Ely).
2	.	1	1	.	3	1	.	1	.	.	3	.	2	2	.	.	4	1	1	2	.	3	3	2	.	Chester.
.	6	.	.	1	.	3	1	1	1	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	3	Cornwall.
.	3	1	2	3	2	1	.	1	1	.	1	2	.	.	.	4	.	.	1	1	1	1	.	.	4	Cumberland.
2	5	4	3	1	1	1	1	1	2	2	.	6	3	1	.	.	1	.	.	1	.	2	1	1	1	Derby.
.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
2	.	3	3	1	.	.	1	.	1	.	5	.	.	3	.	1	.	.	.	.	.	.	.	.	.	Durham.
10	6	15	5	14	2	9	11	16	14	5	13	9	4	3	7	7	7	6	2	5	3	.	1	.	7	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
1	.	.	4	.	3	.	3	1	3	4	1	4	.	1	.	.	.	.	.	.	.	.	.	.	.	Hants.
2	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	7	2	4	2	8	1	3	1	2	1	1	1	5	2	8	5	7	3	.	4	1	1	9	3	.	Hertford (ex. Liberty of St. Albans).
1	1	.	6	5	4	1	2	.	2	1	2	2	1	.	.	3	1	.	3	2	.	.	3	1	2	Huntingdon.
2	3	3	1	.	5	3	2	8	2	.	4	1	1	2	6	3	.	1	1	2	2	1	2	.	1	Kent (ex. Metropolis).
8	9	7	4	12	5	4	9	9	8	9	5	3	8	4	4	7	1	4	8	7	3	3	6	.	3	Lancaster.
10	2	8	5	6	4	2	2	3	6	4	4	4	3	.	2	3	2	2	2	3	2	4	5	1	1	Leicester.
.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	„ „ Lindsey.
3	.	.	.	.	.	.	3	4	1	3	3	4	3	4	3	8	4	.	.	1	4	2	1	3	.	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Monmouth.
22	17	25	19	21	20	13	16	33	34	54	25	42	34	18	24	16	15	21	10	14	19	5	14	8	9	Norfolk.
6	5	3	4	9	2	2	2	4	1	3	5	8	2	4	6	3	6	3	1	3	.	2	2	2	4	Northampton (ex. Soke of Peterboro').
1	2	.	4	.	.	.	2	2	4	5	2	.	1	.	1	1	9	3	.	5	2	5	4	3	2	Northumberland.
1	3	1	.	1	1	.	.	1	.	3	.	.	.	.	.	.	.	4	.	2	.	4	2	.	2	Notts.
2	.	2	.	.	1	1	2	.	.	.	.	.	4	1	.	.	.	.	1	2	.	.	.	1	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	Rutland.
.	4	.	.	4	1	1	1	1	3	2	.	.	.	.	4	.	.	.	1	.	.	2	.	.	.	Salop.
.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	Somerset.
5	3	9	7	6	3	7	3	2	1	6	2	8	4	6	8	5	2	1	2	4	1	2	2	3	4	Stafford.
6	11	11	12	7	7	4	2	13	13	17	18	9	5	5	13	4	2	8	4	4	1	4	1	4	2	Suffolk.
8	4	6	2	6	4	8	2	2	2	5	2	1	3	2	2	2	3	4	.	.	1	.	.	.	.	Surrey (ex. Metropolis).
3	.	5	2	3	3	6	2	1	2	11	2	3	2	2	7	4	1	1	4	4	.	3	.	.	.	Sussex.
1	2	3	1	4	2	1	1	1	2	.	1	1	1	2	2	.	3	.	1	2	.	2	1	.	1	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	2	3	2	.	1	1	1	.	1	.	.	.	.	.	.	1	.	.	Wilts.
2	11	2	3	.	.	3	2	2	1	2	3	1	1	1	.	.	.	1	.	.	1	.	.	.	.	Worcester.
6	2	3	1	2	5	4	1	.	1	5	3	2	1	2	1	5	2	.	.	2	.	.	.	1	.	York, East Riding.
4	3	5	4	2	1	7	.	2	2	1	5	2	1	4	.	1	.	2	2	1	1	.	.	1	2	„ North „
17	8	18	7	7	13	11	8	9	8	11	13	10	10	5	4	3	6	10	7	7	5	8	4	3	2	„ West „
1	1	1	.	.	2	.	.	.	1	.	3	3	.	.	.	.	.	.	.	.	.	1	.	3	2	Liberty of the Isle of Ely.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	Soke of Peterborough.
1	1	.	1	.	.	.	1	1	.	3	3	2	.	.	1	.	.	.	.	.	.	5	1	4	1	Liberty of St. Albans.
5	11	4	15	7	9	7	7	14	7	1	5	7	7	8	4	3	.	5	7	5	5	7	2	5	6	The Metropolis.
																										WALES.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.*
10	3	5	8	6	2	3	15	8	3	1	2	4	4	3	3	4	2	.	1	1	1	1	.	1	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
1	2	2	7	5	1	4	.	1	3	4	1	2	.	.	.	1	1	2	4	.	.	.	.	2	.	Banff.
.	1	.	1	.	1	1	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	1	.	1	.	.	3	2	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
1	2	.	1	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.	2	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
10	8	17	19	15	14	18	12	15	16	5	16	14	13	16	25	11	13	6	6	8	11	6	15	11	6	Edinburgh.
1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
3	1	.	.	2	.	4	2	.	1	7	.	.	2	.	4	2	2	.	1	.	2	1	.	.	3	Fife.
10	8	5	10	16	5	10	14	10	12	13	5	4	6	7	8	12	1	4	2	7	7	4	2	1	2	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	Inverness.
2	5	2	.	1	2	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	3	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	Kinross.
.	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
5	5	11	16	8	9	15	9	11	4	1	.	1	1	8	6	1	1	1	16	2	4	.	2	3	5	Lanark.
.	.	4	2	.	.	.	.	.	.	3	.	.	1	.	.	1	.	.	.	.	.	6	.	.	2	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
2	1	4	8	3	6	26	3	2	.	5	2	5	.	1	.	1	1	2	.	1	.	.	.	.	1	Perth.
1	.	2	1	2	.	.	.	.	1	.	1	.	.	.	.	2	1	.	.	.	.	1	2	.	.	Renfrew.
6	.	.	3	.	.	3	.	1	1	1	.	.	2	2	.	1	.	.	1	.	.	.	.	.	.	Ross.
.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	Stirling.
2	.	1	2	1	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	5	3	3	4	4	5	6	4	1	.	.	2	.	.	1	.	.	1	.	Wigtown.

see Table XIII.; and for the Number Attacked in *Great Britain*, in *each Week*, see Table XVIII.
in Wales, and in Scotland respectively, see Table XII.

TABLE

TABLE showing the Number of CATTLE reported, by the Inspectors of the Local Authorities, to have been
each Week of

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.																										
Bedford	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1
Berks	.	1	.	.	.	.	.	1	.	.	6	2	.	.	8	1	6	.	.	.	.	1	.	.	.	1
Buckingham	1	.	6	.	1	2	.	.	.	.	.	.	.	.	.	.	.	1	1	2	4	2	1	1	2	1
Cambridge (ex. Liberty of Isle of Ely)	6	2	6	4	6	7	3	1	.	1	1	1	1	2	2	3	1	1	3	2	1	3	1	1	4	1
Chester	3	1	.	3	2	.	15	5	.	4	3	1	.	2	1	2	3	4	.	3	.	1	.	3	2	6
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Cumberland	1	.	.	.	1	.	.	3	1	3	2	4	4	.	.	1	.	.	3	1	.	.	.	2	1	1
Derby	4	3	4	2	.	2	2	.	.	.	.	1	.	1	3	1	3	.	2	5	7	7	5	5	1	6
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	4	1	.
Dorset	.	.	.	.	.	1	.	.	1	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	3	1	2
Essex	6	4	8	4	4	7	5	5	3	8	8	4	4	3	9	2	3	4	3	6	7	5	3	6	7	3
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hants	9	6	4	3	6	5	1	1	3	1	3	4	5	1	.	2	2	6	.	.	4	3	2	1	2	4
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	1	4
Hertford (ex. Liberty of St. Albans)	5	6	1	1	2	4	2	.	2	2	1	1	1	7	.	5	5	2	.	1	1	.	1	2	2	.
Huntingdon	4	3	.	1	2	2	5	2	5	.	.	4	2	.	1	2	1	1	1	2	1	.	1	2	3	1
Kent (ex. Metropolis)	5	6	1	1	4	6	5	7	3	.	6	2	2	5	5	2	3	5	2	2	5	5	1	5	2	3
Lancaster	4	4	5	2	2	8	6	3	3	8	3	3	4	2	5	3	5	3	2	2	8	1	8	2	3	8
Leicester	2	1	2	1	1	2	1	1	3	.	3	2	2	5	2	4	7	1	3	4	6	13	5	4	8	13
Lincoln, Parts of Holland	2	1	.	.	.	.	.	.	.	1	.	1	.	2	.	.	2	1	.	.	.	2	.	.	.	.
" " Kesteven	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
" " Lindsey	1	1	.	1	.	.	.	1	1	1	1	1	2	.	.	.	.	.	2	.	2	.	1	.	.	.
Middlesex (ex. Metropolis)	2	2	4	3	.	10	5	1	3	2	10	6	1	.	.	1	.	5	2	.	1	.	.	2	2	2
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	12	[illegible]	21	20	25	24	27	20	15	9	14	[illegible]	14	16	13	12	16	21	8	8	19	16	18	19	28	33
Northampton (ex. Soke of Peterboro')	2	.	1	2	2	2	4	2	.	.	.	1	3	.	2	3	4	3	3	2	.	4	3	7	7	1
Northumberland	.	1	.	.	1	.	1	2	1	1	.	1	1	1	1	.	.	1	.	.	3	.	2	1	.	1
Notts	.	2	.	.	2	.	.	.	1	.	.	.	1	.	1	3	.	1	2	1	.	4	1	3	.	2
Oxford	1	2	.	1	1	.	.	2	1	1	.	.	.	2	1	.	.	.	.	.	.	.	1	1	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	3	3	2	.	.	.	.	1	1	.	1	1	.	1	.	.	.	2	.	3	5	2	1	3	1
Somerset	.	3	4	.	2	3	3	1	3	1	.	1	1	1	4	5	.	.	2	.	2	2	.	.	.	.
Stafford	2	1	1	.	1	1	.	3	4	2	2	.	3	2	1	2	3	3	5	5	2	3	7	5	7	9
Suffolk	8	16	6	7	5	8	5	10	5	10	11	3	6	8	9	2	3	1	2	2	.	9	5	2	7	4
Surrey (ex. Metropolis)	5	3	5	2	2	4	5	3	.	3	1	1	1	2	2	4	4	4	1	.	8	3	1	1	.	3
Sussex	2	.	1	.	3	2	.	.	8	2	1	.	1	.	1	3	1	2	.	1	2	2	.	.	1	1
Warwick	1	1	.	1	1	2	1	1	5	4	.	1	1	3	1	4	4	3	.	3	2	3	1	.	4	1
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	3	.	4	.	.	.	2	.	.	.	1	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Worcester	2	.	.	.	.	.	.	.	1	1	4	.	2	1	.	3	.	1	.	3	.	1	.	3	.	2
York, East Riding	.	.	3	2	.	.	.	.	1	2	1	7	.	.	3	1	4	7	7	5	1	2	2	1	7	4
" North "	.	3	.	.	.	.	4	1	1	.	1	4	5	4	1	9	1	13	4	4	9	2	9	7	6	12
" West "	10	14	5	4	6	10	9	8	2	7	4	6	14	8	8	14	8	9	3	13	13	19	25	17	12	19
Liberty of the Isle of Ely	3	4	2	1	.	2	1	4	3	1	1	2	2	2	2	4	3	1	.	3	.	3	3	.	4	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Liberty of St. Albans	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	2	.	.	.	.
The Metropolis	5	3	6	3	6	1	3	9	7	10	12	7	11	9	7	6	7	6	7	10	8	9	8	6	8	5
WALES.																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.																										
Aberdeen	10	7	6	3	4	14	10	7	7	11	.	8	8	1	1	3	4	8	6	3	11	9	[illegible]	14	20	[illegible]
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7	.	.	.	2	.	.
Ayr	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	.	.	.	.	.	.	.	3	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	1	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	1	.	.	1	.	.	.	2	.	.	.	.	.	.	1	1	3	2	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	10	7	8	12	3	13	9	8	14	8	.	7	.	3	4	2	1	3	2	3	5	7	12	17	16	17
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	1	.	1	.	.
Fife	2	1	3	3	4	2	.	1	1	.	2	1	2	3	.	3	.	2	3	1	.	4	.	1	3	6
Forfar	1	3	3	4	10	8	3	4	1	3	5	3	8	6	6	4	5	9	7	8	7	6	3	13	9	20
Haddington	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	1
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	1	.	1	1	1	2	.	.	.	.	.	.	2	2	2	5	4	.	5	.	.	2	4	3
Kinross	.	.	.	.	.	.	.	1	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	5	12	25	14	7	6	13	9	9	16	10	1	5	19	1	6	8	11	4	3	4	4	1	10	3	2
Linlithgow	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	3	.	1	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	1	.	.	.	.	.	4	.	.	1	3	2	.	2	2	1	1	.	1	.	2	.	4	1	9	3
Renfrew	.	1	.	.	4	.	.	.	.	.	3	.	.	1	1	1	6	1	6	4	.	.	2	3	1	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	12	8	5	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Cattle Killed while suffering from the Disease, in each County, during

XV.

KILLED while suffering from PLEURO-PNEUMONIA, in each County of GREAT BRITAIN, during the Year 1874.

ENDING																										
July				August					September				October					November				December				COUNTIES.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	Bedford.
1	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	Berks.
2	.	1	2	.	2	.	1	1	1	3	1	3	.	.	2	1	4	.	1	.	.	2	1	3	1	Buckingham.
.	.	1	.	2	1	.	1	.	.	.	.	.	2	1	2	.	.	.	1	1	.	.	2	.	1	Cambridge (ex. Liberty of Isle of Ely).
1	1	.	1	.	1	2	.	.	1	.	1	2	2	2	.	.	3	2	.	3	.	3	.	4	.	Chester.
.	.	4	.	1	.	.	4	1	1	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	2	2	1	4	2	1	.	1	1	.	1	2	.	.	.	4	.	.	1	.	2	1	.	.	4	Cumberland.
4	5	4	2	2	1	1	1	1	2	2	.	6	3	1	.	.	1	.	.	.	1	2	1	1	1	Derby.
.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
1	.	3	1	2	.	1	.	.	1	.	4	.	.	3	.	1	.	.	.	.	.	.	.	.	.	Durham.
12	4	12	6	11	3	9	11	16	11	6	13	11	4	3	7	7	7	6	2	3	4	.	1	.	4	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
2	.	.	4	.	.	2	1	2	4	4	1	2	.	3	.	.	.	.	.	.	.	.	.	.	.	Hants.
2	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	5	4	1	5	4	4	4	1	2	1	1	1	.	5	3	4	12	3	.	4	1	1	1	1	10	Hertford (ex. Liberty of St. Albans).
1	1	.	4	6	4	1	2	.	2	1	2	1	2	.	.	3	1	.	3	2	.	.	3	.	1	Huntingdon.
2	.	6	1	.	5	2	2	8	2	.	4	1	1	2	6	2	1	1	1	2	2	1	.	1	1	Kent (ex. Metropolis).
10	8	7	6	11	3	7	7	8	8	8	4	7	3	8	3	7	1	4	6	9	2	4	5	1	1	Lancaster.
9	3	6	7	6	3	3	2	2	5	5	3	4	3	1	2	3	2	2	2	1	3	4	4	2	.	Leicester.
.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	„ „ Lindsey.
2	.	.	.	.	.	.	3	4	.	4	3	4	3	2	3	8	4	.	.	1	3	2	2	3	.	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Monmouth.
[illegible]0	20	24	21	20	22	12	14	36	33	53	24	40	35	18	19	20	15	21	9	16	11	11	13	9	9	Norfolk.
4	6	3	5	4	6	2	2	3	1	2	4	6	2	3	7	2	5	4	1	2	2	2	2	2	3	Northampton (ex. Soke of Peterboro').
1	1	.	1	2	.	.	.	2	4	3	2	.	2	.	.	1	9	1	2	1	5	5	3	4	.	Northumberland.
2	3	.	.	1	1	.	.	1	.	3	.	.	.	.	.	.	.	4	.	1	.	4	.	1	.	Notts.
2	.	2	.	.	1	1	2	.	.	.	.	.	4	1	.	.	.	.	1	2	.	.	.	1	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	Rutland.
.	4	.	.	.	5	1	1	1	3	2	.	.	.	.	3	.	.	.	.	.	.	2	.	.	.	Salop.
.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	Somerset.
6	4	10	6	7	2	7	3	2	2	5	3	5	7	5	9	5	2	.	2	4	2	2	2	3	4	Stafford.
9	9	12	11	6	9	6	2	8	15	15	17	9	5	4	8	4	3	6	6	3	2	4	1	3	2	Suffolk.
5	3	4	5	3	6	7	1	2	2	5	2	1	3	2	.	3	1	4	.	.	1	.	.	.	.	Surrey (ex. Metropolis).
.	2	2	2	3	2	6	2	1	1	10	3	1	3	1	6	3	.	2	2	1	2	2	.	.	.	Sussex.
1	2	3	1	4	2	1	1	1	2	.	1	1	1	2	2	.	2	1	1	2	.	2	1	.	1	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	2	3	2	.	1	1	1	.	1	.	.	.	.	.	.	1	.	.	Wilts.
2	5	7	3	.	.	2	1	3	2	2	3	1	1	.	1	.	.	1	.	.	1	.	.	.	.	Worcester.
6	2	3	1	2	4	4	1	.	1	5	3	2	1	2	1	5	2	.	.	2	.	.	.	1	.	York, East Riding.
4	3	6	4	2	1	6	1	2	2	1	4	2	1	4	.	1	.	2	1	1	.	1	.	1	.	„ North „
16	8	8	12	7	14	9	8	9	8	8	13	10	11	5	4	2	5	11	6	6	3	8	2	4	2	„ West „
1	1	1	.	.	2	.	.	.	1	.	3	2	1	.	.	.	.	.	.	.	.	1	.	3	1	Liberty of the Isle of Ely.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	Soke of Peterborough.
1	1	.	1	.	.	.	1	1	.	2	4	2	.	.	1	.	.	.	.	.	.	5	.	5	1	Liberty of St. Albans.
7	8	6	14	8	7	8	8	14	7	.	6	5	8	7	5	3	.	6	1	10	6	6	3	4	5	The Metropolis.
																										WALES.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.
11	3	4	8	4	3	5	14	9	3	1	1	5	4	3	3	2	4	.	1	1	1	1	.	1	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
2	4	2	5	.	5	5	.	1	3	3	1	3	.	.	.	1	1	.	3	.	.	.	.	3	.	Banff.
.	.	1	1	.	.	1	1	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	1	.	.	1	.	3	2	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
9	2	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.	2	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
10	6	19	17	17	14	18	12	14	16	5	14	13	14	18	24	11	14	4	8	8	10	6	12	14	6	Edinburgh.
1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
3	1	.	.	2	.	4	2	.	1	7	.	.	2	.	3	3	.	1	1	.	1	1	1	.	3	Fife.
12	9	4	6	13	5	15	16	10	13	13	4	4	6	6	8	8	5	5	3	5	8	4	1	2	2	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Inverness.
15	3	4	.	.	1	4	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	2	.	3	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	Kinross.
11	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
5	6	11	16	8	9	15	8	12	4	1	.	1	1	8	6	1	1	1	15	2	4	.	2	3	5	Lanark.
.	.	4	1	1	.	.	.	.	.	2	1	.	1	.	.	1	.	.	.	.	.	.	4	.	2	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
2	1	3	6	5	6	1	6	2	.	5	19	2	3	.	1	1	1	2	.	.	1	.	.	.	1	Perth.
1	.	2	1	2	.	.	.	.	1	.	1	.	.	.	.	2	1	.	.	.	.	1	2	.	.	Renfrew.
.	6	.	2	.	.	3	.	1	1	1	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	Ross.
.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	1	.	.	.	.	.	.	.	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	Stirling.
2	.	1	2	1	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	.	10	4	4	5	6	4	1	.	.	2	.	.	1	.	.	1	.	Wigtown.

the Year, see Table XIII.; and for the Number Killed in *Great Britain*, in *each Week*, see Table XVIII.

TABLE

TABLE showing the Number of CATTLE reported, by the Inspectors of the Local Authorities, during each Week of

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	1	.	.	.	1	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	.	.	.	.	.	1	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	1	.	.	.	.	1	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Derby	.	1	.	.	.	.	.	.	.	.	.	3	.	1	.	.	1	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dorset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Essex	4	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Hants	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1
Huntingdon	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.
Kent (ex. Metropolis)	.	.	.	1	.	.	1	.	.	.	.	.	1	2	.	.	.	1	.	.	.	.	.	1	.	.
Lancaster	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	3
Leicester	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	3	.	2	.	.	.	5	1	.	.	.	.	1	.	1	.	.	.	.	.	1	.	.	1	.	1
Northampton (ex. Soke of Peterboro')	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	1	.	.	.	3
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	1	1	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Somerset	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stafford	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	.	2	.	.
Suffolk	1	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.
Sussex	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Warwick	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" North "	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	2	.	.	.	1	.	.	.
" West "	.	.	.	1	.	.	1	.	.	.	.	1	.	.	.	2	2	.	.	.	1	1	1	.	.	1
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
WALES.																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.																										
Aberdeen	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	1	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fife	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	1	.	.	.	.	1
Forfar	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	.	.	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Cattle which Died from the Disease, in each County, during

VI.

have **DIED** from **PLEURO-PNEUMONIA,** in each County of Great Britain,
e Year 1874.

DING

July			August					September				October					November				December				Counties.
11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																									ENGLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
1	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
1	.	3	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	Hertford (ex. Liberty of St Albans).
.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	Huntingdon.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	Kent (ex. Metropolis).
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Monmouth.
.	.	.	.	.	2	.	.	1	.	.	.	.	1	1	.	1	.	.	.	.	.	.	1	.	Norfolk.
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	1	.	1	.	.	.	1	.	1	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	Northumberland.
.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	Rutland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Somerset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stafford.
.	.	.	.	.	.	.	2	.	3	1	.	.	1	4	.	.	.	.	.	.	.	.	.	.	Suffolk.
1	2	.	.	1	1	1	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
1	2	1	.	1	.	.	.	.	1	.	1	.	.	1	1	.	.	1	.	.	.	1	1	.	Sussex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wilts.
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	„ North „
.	1	3	.	.	1	1	.	.	1	1	.	.	.	.	.	.	1	.	2	1	.	1	1	.	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of St. Albans.
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	The Metropolis.
																									WALES.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																									SCOTLAND.
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	1	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Renfrew.
.	.	1	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	.	.	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

the Year, see Table XIII.; and for the Number which Died in *Great Britain*, in *each Week*, see Table XVIII.

TABLE

TABLE showing the Number of **HEALTHY CATTLE** reported, by the Inspectors of the Local Authorities, County of GREAT BRITAIN, during

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	2	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle o Ely)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.
Chester	.	.	.	.	1	.	.	3	.	.	2	5	.	2	.	.	.	2	.	.	.	.	.	1	.	2
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Derby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Dorset	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Essex	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	.
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hants	.	.	6	10	3	5	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Huntingdon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kent (ex. Metropolis)	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Lancaster	4	.	.	.	4	9	1	.	.	.	3	.	.	.	.	.	.	1	.	.	.	.	1	1	4	.
Leicester	.	.	.	.	.	1	.	.	.	.	.	.	2	.	.	.	.	2	1	.	2	.	1	.	.	1
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ „ Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ „ Lindsey	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	.	.	.	5	2	.	1	.	.	.	2	4	.	.	1	.	2	.	.	.	.	.	.	.	.	.
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	3	2	29	6	2	.	.	.	.	.	1	.	.	.	.	3	.	.	.	.	.	1	.	.
Somerset	.	.	.	.	.	.	.	2	.	1	.	.	.	2	.	.	.	.	2	.	4	.	.	.	.	.
Stafford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Suffolk	.	1	.	.	.	.	.	.	.	.	14	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	.	.	3	.	.	4	.	4	3	.	.	6	.	.	4	.	.	.	.	.	.	.	.	.	.	.
Sussex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warwick	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ North „	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ West „	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	.	.	.	.	.	.	.	.	.	4	2	.	1	.	.	.	1	.	1	6	.	1	1	4	.	.
WALES.																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.																										
Aberdeen	.	.	.	.	.	.	.	.	1	.	.	.	1	.	1	.	.	.	.	.	2	5	1	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	5	.	.	3	2	.	1	.	2	1	.	.	.	.	.	1	.	.	.	.	.	1	.	1
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	2	.	.	.	.
Fife	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	1	1	.	5	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	2	.	.	2	.	.	.	2	6	.	2	1	.	.	.	2	.	.
Renfrew	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	26	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Healthy Cattle Slaughtered to prevent the spread of the Disease, in each County,

XVII.

to have been **SLAUGHTERED** on Premises infected with **PLEURO-PNEUMONIA,** in each each Week of the Year 1874.

ENDING July				August					September				October					November				December				Counties.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
5	5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Cumberland.
.	.	5	4	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Huntingdon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kent (ex. Metropolis).
.	.	.	.	.	.	.	2	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	Lancaster.
.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
.	2	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	1	.	2	.	1	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Monmouth.
2	.	.	.	.	.	.	.	.	1	1	.	11	.	.	.	.	1	.	.	.	.	.	.	.	.	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
.	.	.	.	.	1	4	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	Somerset.
.	.	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stafford.
.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	.	.	.	.	Suffolk.
.	.	.	14	.	1	.	.	.	.	4	.	.	.	.	14	.	.	.	1	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	1	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	3	2	.	.	Sussex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2	.	Wilts.
.	1	.	.	.	.	1	1	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ North „
.	.	.	.	.	.	.	.	1	.	.	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of St. Albans.
.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	The Metropolis.
																										WALES.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.
.	.	1	.	.	.	.	7	13	3	.	.	1	.	.	.	.	.	4	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	1	.	.	3	3	1	2	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	3	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
1	.	.	.	.	1	2	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	1	16	6	.	.	.	10	4	.	1	.	.	1	.	.	2	.	2	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	6	13	.	1	.	.	3	2	.	.	.	.	2	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

during the Year, see Table XIII.; and for the Number Slaughtered in *Great Britain*, in *each Week*, see Table XVIII.

TABLE XVIII.

TABLE showing the PROGRESS of **PLEURO-PNEUMONIA** in GREAT BRITAIN during the Year 1874; compiled from the Weekly Returns received from the Inspectors of the Local Authorities, and corrected in accordance with subsequent correspondence.

Weeks ending	Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Total Number of Farms or other Places upon which the Disease existed in each Week.	Healthy Cattle on infected Premises.		Attacked.		Diseased Cattle.			
				Slaughtered.	Removed.	Remaining diseased from the previous Week.	Attacked in each Week.	Killed.	Died.	Recovered.	Remaining diseased at the end of each Week.
January 3	46	69	243	5	5	34	162	146	10	...	40
,, 10	45	79	250	1	4	40	161	149	5	1	46
,, 17	42	64	232	19	32	46	156	149	8	1	44
,, 24	44	57	221	19	...	44	121	110	5	...	50
,, 31	43	64	231	39	24	50	143	122	5	2	64
February 7	42	56	228	28	25	64	135	159	3	...	37
,, 14	44	67	225	8	4	37	154	155	11	...	25
,, 21	43	55	220	12	9	25	132	129	2	...	26
,, 28	43	42	209	10	5	26	113	121	3	...	15
March 7	43	51	196	5	6	15	135	128	2	2	18
,, 14	42	50	196	29	11	18	135	124	5	...	24
,, 21	45	64	202	23	32	24	142	122	13	...	31
,, 28	43	57	200	10	9	31	119	121	5	...	24
April 4	43	48	190	4	11	24	145	125	8	3	33
,, 11	47	50	188	6	43	33	116	116	2	1	30
,, 18	45	73	212	3	8	30	154	133	7	...	44
,, 25	46	48	202	13	19	44	115	130	6	3	20
May 2	47	65	207	12	6	20	162	155	7	...	20
,, 9	47	43	192	14	31	20	120	105	6	...	29
,, 16	47	59	199	10	13	29	133	125	2	...	35
,, 23	44	82	288	8	36	35	175	159	8	1	42
,, 30	49	83	246	9	15	42	179	175	10	3	33
June 6	44	83	255	6	22	33	186	163	3	2	51
,, 13	48	80	276	29	12	51	187	190	5	...	43
,, 20	50	88	301	33	15	43	225	209	1	...	58
,, 27	51	90	308	4	15	58	252	224	13	1	72
July 4	49	87	299	9	55	72	192	220	5	1	38
,, 11	52	77	283	9	14	38	173	157	6	1	47
,, 18	54	95	313	14	4	47	201	200	9	1	38
,, 25	53	91	310	19	21	38	207	194	10	2	39
August 1	51	78	317	6	6	39	187	177	4	...	45
,, 8	51	64	294	12	23	45	166	168	6	1	36
,, 15	50	62	273	28	31	36	193	182	5	...	42
,, 22	48	51	245	22	13	42	156	149	4	...	45
,, 29	48	68	255	14	15	45	194	187	7	1	44
September 5	48	71	254	14	9	44	178	185	2	...	35
,, 12	44	80	270	24	33	35	210	196	6	1	42
,, 19	47	69	262	19	62	42	167	176	8	...	25
,, 26	51	77	276	19	...	25	178	171	2	...	30
October 3	50	54	262	12	24	30	143	150	2	...	21
,, 10	44	58	245	4	...	21	126	127	4	...	16
,, 17	40	70	233	17	...	16	158	140	8	1	25
,, 24	43	62	212	3	2	25	128	120	8	...	25
,, 31	40	44	180	12	6	25	104	109	3	...	17
November 7	43	49	180	7	25	17	99	98	4	...	14
,, 14	42	47	177	1	2	14	94	86	4	...	18
,, 21	41	50	176	3	37	18	104	94	3	...	25
,, 28	42	40	161	4	11	25	83	81	5	...	22
December 5	46	44	160	5	1	22	92	90	2	...	22
,, 12	47	46	154	9	11	22	92	75	7	1	31
,, 19	47	28	138	8	...	31	78	83	6	1	19
,, 26	44	33	131	2	13	19	80	75	4	...	20
Total -	...	3,262	...	655	830	*...	7,740	7,434	289	31	†...

Note.—For the *Aggregate Results* in *each County*, see Table XIII. For the Number Slaughtered Healthy in *each County*, in each Week, see Table XVII.; Attacked, Table XIV.; Killed, Table XV.; and Died, Table XVI.

* 34 Cattle were remaining diseased from the previous year.

† 20 Cattle were remaining diseased at the end of the year.

TABLE XIX.

TABLE showing the PROGRESS of **SHEEP-SCAB** in GREAT BRITAIN during the Year 1874; compiled from the Weekly Returns received from the Inspectors of the Local Authorities.

Weeks ending		Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Total Number of Farms or other Places upon which the Disease existed in each Week.	Healthy Sheep on infected Premises.		Attacked.	Diseased Sheep.		
					Slaughtered.	Removed.		Killed.	Died.	Recovered.
January	3	42	61	330	...	174	2,478	25	10	1,172
,,	10	39	64	344	...	...	940	21	25	1,104
,,	17	39	65	382	...	...	1,803	11	24	1,029
,,	24	41	77	415	21	92	3,058	27	10	568
,,	31	42	49	416	20	30	1,783	3	5	1,110
February	7	43	52	417	3	3	1,297	84	7	978
,,	14	42	34	367	1	...	837	9	13	1,149
,,	21	41	46	360	2	...	1,004	35	6	1,725
,,	28	38	26	318	1	30	503	18	11	1,011
March	7	37	33	316	9	8	829	9	3	969
,,	14	34	22	274	1	186	678	...	11	1,053
,,	21	31	22	248	...	1	442	...	6	1,196
,,	28	29	16	226	...	25	445	...	18	988
April	4	29	15	205	...	1	390	...	7	502
,,	11	28	5	168	1	147	60	...	12	872
,,	18	27	7	148	...	...	95	...	6	424
,,	25	30	14	141	...	104	627	...	7	792
May	2	26	14	120	...	37	636	...	4	947
,,	9	24	3	99	...	...	38	...	1	149
,,	16	26	7	94	...	...	99	1	...	566
,,	23	26	4	72	...	...	82	...	1	248
,,	30	24	7	70	...	...	215	...	24	155
June	6	25	20	76	...	...	424	...	2	523
,,	13	25	12	67	...	67	244	...	3	172
,,	20	21	9	65	...	33	324	...	1	424
,,	27	20	7	67	...	...	974	...	...	526
July	4	19	3	55	1	...	53	...	...	131
,,	11	17	6	49	...	...	294	...	2	94
,,	18	19	8	53	...	...	830	...	1	353
,,	25	18	6	48	...	...	79	...	...	75
August	1	15	5	39	...	...	217	...	...	304
,,	8	16	4	35	...	...	834	7	...	246
,,	15	17	4	35	...	...	215	...	7	166
,,	22	20	9	38	...	48	786	...	1	123
,,	29	19	13	40	5	...	872	2	1	23
September	5	23	11	57	10	18	389	7	1	338
,,	12	24	16	62	10	1	474	3	...	309
,,	19	25	20	69	...	...	1,515	...	5	684
,,	26	29	25	82	69	...	796	...	7	997
October	3	27	22	90	...	...	1,154	28	3	643
,,	10	30	34	109	20	60	1,444	...	4	810
,,	17	30	24	109	27	75	393	...	13	601
,,	24	32	32	129	...	88	745	...	...	361
,,	31	32	28	139	25	94	1,101	37	3	1,117
November	7	28	63	167	...	34	1,571	14	9	432
,,	14	31	43	188	1	145	865	15	5	482
,,	21	31	78	235	3	...	2,209	10	5	654
,,	28	35	39	226	...	...	693	10	2	551
December	5	35	60	251	10	4	1,478	...	4	447
,,	12	34	63	280	7	...	2,770	...	12	440
,,	19	33	51	297	1	37	1,156	...	1	650
,,	26	39	60	329	120	2	1,251	3	21	597
Total	-	—	1,418	—	368	1,544	44,489	379	324	31,980

Note.—For the *Aggregate Results* in *each County*, see Table XX. For the Number Attacked, in *each County*, in each Week, see Table XXI.

TABLE

NUMBER of FARMS or other PLACES in the COUNTIES of GREAT BRITAIN upon which Fresh Outbreaks of
Year 1874; with the Number of Sheep reported to have been Attacked,

COUNTIES, &c.	Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Healthy Sheep on infected Premises.		Attacked.	Diseased Sheep.		
			Slaughtered.	Removed.		Killed.	Died.	Recovered.
GREAT BRITAIN *	62	1,418	368	1,544	†44,489	†379	324	31,980
ENGLAND *	43	1,161	173	727	39,417	318	271	27,260
WALES *	8	187	185	238	2,707	23	30	2,581
SCOTLAND *	11	70	10	579	2,365	38	23	2,139
ENGLAND.								
Bedford		...	...	...	...	...	...	...
Berks		2	...	...	143	...	1	23
Buckingham		20	...	...	453	...	2	503
Cambridge (ex. Liberty of the Isle of Ely)		8	...	...	171	...	...	205
Chester		35	...	...	531	...	6	494
Cornwall		21	4	...	829	8	2	496
Cumberland		25	11	...	388	...	...	260
Derby		10	...	...	74	...	...	94
Devon		171	...	...	2,860	15	19	1,602
Dorset		1	...	...	43	...	1	3
Durham		84	26	170	1,772	50	37	1,549
Essex		4	...	...	631	1	29	354
Gloucester		5	...	...	770	5	7	869
Hants		1	...	...	300	...	...	300
Hereford		5	...	...	555	...	...	655
Hertford (ex. Liberty of St. Albans)		1	...	...	93	...	...	102
Huntingdon		19	...	...	811	...	1	960
Kent (ex. Metropolis)		46	2	223	1,608	121	30	1,231
Lancaster		19	...	...	231	...	9	212
Leicester		2	...	...	125	...	...	271
Lincoln, Parts of Holland		21	...	...	1,739	...	...	1,576
,, ,, Kesteven		3	...	...	667	...	6	762
,, ,, Lindsey		1	...	...	46	23	...	223
Middlesex (ex. Metropolis)		...	...	...	...	...	...	18
Monmouth		184	...	...	7,929	...	4	1,713
Norfolk		28	...	...	2,934	...	4	1,672
Northampton (ex. Soke of Peterborough)		...	...	...	...	...	...	...
Northumberland		31	8	...	590	...	20	682
Notts		1	...	...	74	...	...	...
Oxford		7	1	...	720	...	...	871
Rutland		...	...	...	...	...	...	...
Salop		105	1	32	2,535	...	16	1,260
Somerset		110	...	...	3,150	37	13	1,830
Stafford		22	2	186	507	10	11	484
Suffolk		2	...	...	183	...	...	477
Surrey (ex. Metropolis)		3	...	...	369	...	17	502
Sussex		16	...	...	392	...	5	232
Warwick		22	...	25	769	7	...	560
Westmorland		6	...	...	49	...	...	72
Wilts		1	...	...	82	...	...	82
Worcester		34	...	...	1,550	22	4	1,054
York, East Riding		2	118	...	30	3	...	...
,, North ,,		49	...	91	1,881	1	22	2,546
,, West ,,		29	...	...	754	...	3	395

Note.—For the *Weekly Progress* of the Disease in Great Britain, see Table XIX.; and for

* For the *Results* of the Disease in Great Britain in *each of the Years 1870, 1871, 1872, 1873, and 1874*, see Table VIII. For the Britain respectively, in each Year, see Table IX.; and for the Proportion per Cent. of the Number of Diseased Sheep, Killed, Died, and in Wales, in Scotland, and in Great Britain respectively, see Table XII.; and for the *Proportion per Cent.* of the Number of Diseased

† In addition to the above, 119 Foreign Sheep were Imported, which were affected

XX.

SHEEP-SCAB were reported, by the Inspectors of the Local Authorities, to have occurred, during the
to have been Killed, to have Died, and to have Recovered.

Counties (*continued*).	Number of Farms or other Places upon which Fresh Outbreaks took place.	Healthy Sheep on infected Premises.		Attacked.	Diseased Sheep.		
		Slaughtered.	Removed.		Killed.	Died.	Recovered.
ENGLAND—*continued.*							
Liberty of the Isle of Ely	4	...	...	64	...	2	66
Soke of Peterborough	...	...	...	...	...	...	...
Liberty of St. Albans	...	...	...	...	...	...	...
The Metropolis	1	...	...	15	15	...	...
WALES.							
Anglesey	...	...	...	...	...	...	...
Brecon	31	...	...	332	...	...	...
Cardigan	9	...	...	92	...	...	96
Carmarthen	...	...	...	...	...	...	...
Carnarvon	1	...	...	1	...	...	...
Denbigh	29	1	118	470	...	3	259
Flint	12	183	48	466	13	5	824
Glamorgan	6	...	...	29	...	...	135
Merioneth	12	...	37	319	...	7	337
Montgomery	87	1	35	998	10	15	930
Pembroke	...	...	...	...	...	...	...
Radnor	...	...	...	...	...	...	...
SCOTLAND.							
Aberdeen	1	...	...	112	...	...	112
Argyll	...	...	...	...	...	...	...
Ayr	...	...	...	...	...	...	...
Banff	...	...	...	...	...	...	...
Berwick	18	6	27	751	31	7	692
Bute	4	...	...	29	...	...	2
Caithness	...	...	...	...	...	...	...
Clackmannan	...	...	...	...	...	...	...
Cromarty	...	...	...	...	...	...	...
Dumbarton	...	...	...	...	...	...	...
Dumfries	6	...	...	37	...	...	...
Edinburgh	1	1	88	38	...	...	38
Elgin, or Moray	13	...	...	195	...	...	143
Fife	2	...	...	94	...	...	44
Forfar	...	...	...	...	...	...	...
Haddington	15	3	362	474	7	6	442
Inverness	...	...	...	...	...	...	...
Kincardine	...	...	...	...	...	...	...
Kinross	...	...	...	...	...	...	...
Kirkcudbright	...	...	...	...	...	...	...
Lanark	4	...	...	72	...	...	68
Linlithgow	1	...	...	101	...	...	101
Nairn	...	...	...	...	...	...	...
Orkney	...	...	...	...	...	...	...
Peebles	...	...	...	...	...	...	...
Perth	...	...	...	...	...	...	...
Renfrew	...	...	...	...	...	...	...
Ross	...	...	...	...	...	...	...
Roxburgh	5	...	102	462	...	10	497
Selkirk	...	...	...	...	...	...	...
Shetland	...	...	...	...	...	...	...
Stirling	...	...	...	...	...	...	...
Sutherland	...	...	...	...	...	...	...
Wigtown	...	...	...	...	...	...	...

the Number Attacked, in each County, in *each Week*, see Table XXI.
Proportion per Cent. which the Numbers Attacked bear to the Total Number of Sheep in England, in Wales, in Scotland, and in Great
Recovered respectively, in each Year, see Table X. For the Number of Sheep *Attacked* in *each Week* of the Year 1874, in England,
Sheep Killed, Died, and Recovered respectively, in the Year 1874, see Table XI.
with Sheep-Scab. They were all slaughtered at the place of landing.

TABLE

TABLE showing the Number of SHEEP reported, by the Inspectors of the Local Authorities, to each Week of

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.*																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	13	.	.	.	.	.	.	10	.	.	.	.	.
Buckingham	35	22	11	10	.	.	18	5	68	9	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	46	.	.	.	9	.	.	72	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	56	55	115	.	34	11	47	17	3	17	4	.	12	.	9	.	.	4	.	.	.	.	.	.	.	.
Cornwall	.	3	14	20	.	.	.	.	.	.	.	.	.	.	.	.	5	50	.	.	.	.	.	.	.	.
Cumberland	27	5	20	93	15	37	10	.	.	.	1	.	6	2	.	.	.	.	.	.	.	.	.	.	.	.
Derby	10	.	33	13	15	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	55	53	7	354	8	7	6	105	7	.	1	2	59	14	.	.	47	11	.	11	11	1	7	9	127	7
Dorset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	68	48	82	62	46	5	13	45	12	221	60	56	60	18	5	7	110	11	.	6	.	.	.	.	.	.
Essex	.	.	.	505	.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gloucester	18	.	6	4	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	430	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Huntingdon	.	.	100	8	85	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.	.	.	.	.
Kent (ex. Metropolis)	27	87	.	72	117	67	.	236	.	.	.	.	1	.	.	1	3	.	.	3	.	.	101	.	8	.
Lancaster	1	1	.	3	.	.	10	.	3	1	.	.	8	2	.	.	.	.	.	.	.	.	.	46	.	.
Leicester	.	.	50	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.	.	.	.	58
„ „ Kesteven	.	.	.	.	.	300	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ „ Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monmouth	932	53	341	839	249	350	158	180	123	184	107	61	9	113	10	.	39	12	.	.	.	.	44	.	.	.
Norfolk	468	.	118	.	48	49	.	.	.	.	.	.	60	.	.	.	.	.	.	.	.	.	.	14	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	4	.	2	.	.	.	.	.	.	.	10	.	.	.	.	.	208	.	.	15	.	35	.	10	.	4
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	50	33	.	.	283	.	.	.	.	138	168	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	107	171	66	32	27	55	25	21	34	2	7	110	72	6	.	7	2	.	.	.	.	.	.	7	.	900
Somerset	67	107	195	172	52	21	14	83	.	50	51	122	23	60	2	.	.	4	15	58	.	9	66	30	.	.
Stafford	5	28	89	24	1	25	54	2	102	47	3	3	.	66	.	.	.	.	.	6	.	.	9	.	.	.
Suffolk	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	240	50	.	64	.	.	.	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sussex	.	26	1	36	7	10	146	2	39	.	.	2	4	.	.	.	78	.	.	.	.	.	.	.	.	.
Warwick	55	.	32	35	24	.	5	10	11	11	42	19	.	.	.	.	30	.	3	.	.	.	.	.	.	.
Westmorland	12	.	1	.	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	18	30	264	21	28	135	23	68	1	103	24	6	119	26	.	.	1	.	.	.	.	34	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
„ North „	65	52	71	581	3	.	6	25	.	.	88	.	.	.	.	.	10	160	.	.	.	.	6	.	148	.
„ West „	4	17	110	24	.	.	.	5	2	.	4	2	7	1	.	10	.	13	5	.	.	5	.	1	.	.
Liberty of the Isle of Ely	.	1	.	.	.	1	.	.	.	.	.	.	.	.	2	60	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
WALES.*																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	6	26	.	.	17	.	.	2	10	11	14	.	.	.	.	.	.	.	.	.	.	23	63	.	.
Cardigan	.	.	.	.	45	.	.	21	.	4	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	11	.	8	.	16	7	7	91	6	5	45	28	.	.	.	.	.	.	.	.	.	.	.
Flint	.	1	1	.	20	.	.	.	15	1	.	.	.	.	.	10	.	133	.	.	.	.	.	.	.	.
Glamorgan	.	.	11	8	2	4	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	3	.	91	33	161	2	1	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.
Montgomery	84	91	33	55	43	91	47	45	10	14	6	10	.	20	.	.	.	.	15	.	.	5	34	14	.	5
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.*																										
Aberdeen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	20	.	7	4	5	.	.	.	.	.	.	.	236	.	.	.	30	114	50	40	.
Bute	.	.	.	2	.	.	.	20	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.
Elgin, or Moray	.	.	.	13	35	46	.	2	.	.	.	.	.	.	.	.	6	.	.	.	.	26	.	.	.	.
Fife	.	.	.	.	50	.	44	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	87	.	.	.	.	70	5	.	1	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	4	.	.	.	.	.	21	.	43	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Roxburgh	3	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Sheep Attacked with the Disease, in each County, during the Year,

* For the Number Attacked in each Week, in England, in

XXI.

have been **ATTACKED** with **SHEEP-SCAB**, in each County of Great Britain, during the Year 1874.

ENDING July				August					September				October					November				December				Counties.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	120	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	31	101	3	4	.	15	1	4	20	6	10	7	71	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	17	.	.	13	1	1	.	.	.	5	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	14	1	16	90	5	16	Chester.
.	.	.	.	.	.	.	224	.	.	40	.	.	.	58	.	.	14	65	.	85	21	69	2	121	38	Cornwall.
.	.	2	.	.	.	.	.	40	10	.	.	84	.	11	.	6	.	.	.	8	4	.	.	2	5	Cumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
9	11	1	24	.	60	.	7	59	4	77	201	24	199	167	8	21	17	239	38	75	26	12	324	196	152	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	43	.	.	.	.	.	.	.	.	Dorset.
.	.	.	20	.	103	100	.	28	45	.	4	.	43	3	3	14	.	98	48	36	74	89	25	3	101	Durham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	102	.	.	Essex.
.	.	.	.	.	137	.	.	600	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	300	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	40	68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	2	.	.	.	Hereford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	93	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	16	20	.	.	151	2	114	120	.	1	.	.	140	.	.	.	4	.	.	.	Huntingdon.
.	.	70	.	.	.	.	.	.	.	.	12	29	49	.	21	8	.	15	107	302	7	15	110	94	46	Kent (ex. Metropolis).
.	.	.	.	.	.	.	.	.	10	.	.	82	.	.	.	.	.	.	.	23	21	4	.	8	8	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	75	Leicester.
.	.	250	.	.	500	.	.	20	100	.	632	.	.	.	.	6	.	.	.	38	.	.	106	.	18	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	300	.	.	.	.	.	.	.	.	.	.	.	.	.	65	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	46	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Middlesex (ex. Metropolis).
.	.	.	.	161	.	92	.	.	.	76	.	26	.	135	.	56	299	450	228	785	169	281	655	456	256	Monmouth.
.	118	85	.	.	.	.	.	.	.	.	.	195	212	.	.	211	100	74	.	340	.	3	780	29	30	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	12	2	2	.	30	.	.	24	.	15	.	.	6	22	.	39	16	59	12	20	15	28	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	74	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	.	12	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
.	.	4	.	.	32	.	.	100	50	45	140	.	73	50	12	1	.	44	12	33	46	23	96	11	112	Salop.
.	.	.	20	.	.	.	40	.	.	.	89	54	106	621	69	72	145	70	116	73	52	213	5	50	154	Somerset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	41	.	.	.	.	.	2	.	.	.	.	Stafford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	180	.	.	.	.	.	.	.	.	.	.	.	Suffolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	.	.	.	10	.	.	.	.	.	.	.	.	.	.	.	.	.	15	12	.	4	Sussex.
.	.	.	.	.	.	.	.	2	30	25	73	35	.	.	.	.	265	5	.	12	.	5	23	2	15	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	5	3	2	.	.	.	.	.	.	.	4	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	82	.	.	.	.	.	Wilts.
.	.	.	.	.	.	7	.	.	25	20	223	.	22	10	10	.	3	50	3	112	52	44	10	20	38	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	27	.	.	.	.	.	.	.	.	.	.	.	3	York, East Riding.
2	.	.	.	.	.	.	.	.	.	.	.	20	.	83	114	150	2	83	34	1	23	75	79	.	.	„ North „
.	.	.	.	89	.	.	70	.	.	.	.	.	.	.	24	.	.	.	.	18	.	178	172	40	3	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of St. Albans.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	The Metropolis.
																										WALES.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	72	.	.	.	.	3	5	11	35	.	.	27	7	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	18	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	32	21	.	135	34	.	24	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	50	.	.	32	1	.	195	7	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	19	.	.	5	Merioneth.
5	.	.	.	.	.	.	5	.	11	5	.	.	.	7	26	25	76	1	3	57	42	33	43	10	27	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	112	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Banff.
37	30	.	.	.	.	.	.	.	20	.	34	.	.	7	40	25	.	3	.	7	.	4	.	33	5	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	2	5	.	20	.	.	.	4	Dumfries.
.	.	23	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	47	.	20	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	27	.	15	.	.	44	8	82	10	.	.	.	8	.	.	21	49	46	.	.	1	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	101	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ross.
.	95	.	3	.	.	.	.	5	2	1	.	.	228	81	.	.	.	5	.	.	6	12	9	3	4	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

see Table XX.; and for the Number Attacked in *Great Britain*, in *each Week*, see Table XIX.
Wales, and in Scotland respectively, see Table XII.

TABLE

Number of Farms or other Places in the Counties of Great Britain upon which Fresh Outbreaks of Year 1874; with the Number of Horses reported to have been Attacked,

Counties, &c.	Number of Counties reported from.	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Horses on infected Premises.		Attacked.		Diseased Horses.			
					Slaughtered	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
GREAT BRITAIN*	42	9	401	410	3	1	25	†507	†477	24	19	12
ENGLAND* - -	33	8	360	368	3	1	25	†452	†428	21	17	11
WALES* - -	2	...	2	2	...	...	...	2	1	1	...	...
SCOTLAND* - -	7	1	39	40	...	...	...	53	48	2	2	1
ENGLAND.												
Bedford - - -		...	1	1	...	...	...	1	...	...	...	1
Berks - - -		1	...	1	...	...	5	...	...	1	...	4
Buckingham - -		...	4	4	...	...	...	4	4	...	...	...
Cambridge (ex. Liberty of I. of Ely)		...	1	1	...	...	...	1	1	...	...	...
Chester - - -		...	1	1	...	...	...	1	1	...	...	...
Cornwall - -		...	...	...	...	...	...	...	...	...	...	...
Cumberland - -		...	...	...	...	...	...	...	...	...	...	...
Derby - - -		...	1	1	...	...	...	2	2	...	...	...
Devon - - -		...	2	2	...	...	...	5	1	...	...	4
Dorset - - -		1	...	1	...	...	1	...	...	...	1	...
Durham - - -		...	7	7	...	...	...	25	22	2	1	...
Essex - - -		...	17	17	...	...	...	19	18	...	1	...
Gloucester - - -		1	2	3	...	...	2	2	2	...	2	...
Hants - - -		...	2	2	...	...	...	4	4	...	...	...
Hereford - - -		...	1	1	...	...	...	2	...	...	2	...
Hertford (ex. Liberty of St. Albans)		...	8	8	...	...	...	10	7	3	...	...
Huntingdon - -		...	...	...	...	...	...	...	...	...	...	...
Kent (ex. Metropolis) -		...	8	8	...	...	...	8	8	...	...	...
Lancaster - -		...	4	4	...	...	...	†4	†2	2	...	...
Leicester - - -		...	1	1	...	...	...	1	1	...	...	...
Lincoln, Parts of Holland -		...	...	...	...	...	...	...	...	...	...	...
,, ,, Kesteven -		...	...	...	...	...	...	...	...	...	...	...
,, ,, Lindsey -		...	...	...	...	...	...	...	...	...	...	...
Middlesex (ex. Metropolis) -		2	24	26	1	...	2	25	25	2	...	...
Monmouth - -		...	3	3	...	...	...	5	4	1	...	...
Norfolk - - -		...	4	4	...	...	...	6	6	...	...	...
Northampton (ex. Soke of Peterbro')		...	1	1	...	...	...	1	1	...	...	...
Northumberland - -		...	...	...	...	...	...	...	...	...	...	...
Notts - - -		...	...	...	...	...	...	...	...	...	...	...
Oxford - - -		...	...	...	...	...	...	...	...	...	...	...
Rutland - - -		...	...	...	...	...	...	...	...	...	...	...
Salop - - -		...	2	2	...	...	...	2	2	...	...	...
Somerset - - -		...	1	1	...	...	...	1	...	1	...	...
Stafford - - -		...	12	12	...	...	...	15	14	...	1	...
Suffolk - - -		...	2	2	...	...	...	2	1	...	...	1
Surrey (ex. Metropolis) -		...	4	4	...	...	...	7	7	...	...	...
Sussex - - -		1	6	7	...	...	12	10	13	...	9	...
Warwick - - -		...	9	9	...	...	...	10	10	...	...	...
Westmorland - -		...	...	...	...	...	...	...	...	...	...	...
Wilts - - -		...	...	...	...	...	...	...	...	...	...	...
Worcester - - -		...	...	...	...	...	...	...	...	...	...	...
York, East Riding - -		...	2	2	...	1	...	9	8	1	...	...
,, North ,, - -		...	...	...	...	...	...	...	...	...	...	...
,, West ,, - -		...	5	5	...	...	...	6	5	1	...	...

Note.—For the *Weekly Progress* of the Disease in Great Britain, see Table XXV. For the Numbers Attacked,

* For the *Results* of the Disease in Great Britain in *each of the Years 1870, 1871, 1872, 1873, and 1874*, see Table VIII. For the
and for the Proportion per Cent. of the Number of Diseased Horses Killed, Died, and Recovered respectively, in each Year, see Table X.
Table XII.; and for the *Proportion per Cent.* of the Number of Diseased Horses Killed Died, and Recovered respectively, in the Year

XXII.

GLANDERS were reported, by the Inspectors of the Local Authorities, to have occurred, during the to have been Killed, to have Died, and to have Recovered.

COUNTIES (*continued*).	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Horses on infected Premises.		Attacked.		Diseased Horses.			
				Slaughtered	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
ENGLAND—*cont.*											
Liberty of the Isle of Ely -	...	1	1	...	...	...	1	1	...	...	...
Soke of Peterborough -	...	...	...	...	...	...	...	...	...	...	...
Liberty of St. Albans -	...	4	4	...	...	...	4	4	...	...	...
The Metropolis - -	2	220	222	2	...	3	259	254	7	...	1
WALES.											
Anglesey - - -	...	...	...	...	...	...	...	...	...	...	...
Brecon - - -	...	...	...	...	...	...	...	...	...	...	...
Cardigan - - -	...	...	...	...	...	...	...	...	...	...	...
Carmarthen - -	...	...	...	...	...	...	...	...	...	...	...
Carnarvon - - -	...	...	...	...	...	...	...	...	...	...	...
Denbigh - - -	...	1	1	...	...	...	1	1	...	...	...
Flint - - -	...	...	...	...	...	...	...	...	...	...	...
Glamorgan - -	...	1	1	...	...	...	1	...	1	...	...
Merioneth - - -	...	...	...	...	...	...	...	...	...	...	...
Montgomery - -	...	...	...	...	...	...	...	...	...	...	...
Pembroke - - -	...	...	...	...	...	...	...	...	...	...	...
Radnor - - -	...	...	...	...	...	...	...	...	...	...	...
SCOTLAND.											
Aberdeen - - -	...	1	1	...	...	...	1	1	...	...	...
Argyll - - -	...	1	1	...	...	...	2	1	...	1	...
Ayr - - -	...	...	...	...	...	...	...	...	...	...	...
Banff - - -	...	...	...	...	...	...	...	...	...	...	...
Berwick - - -	...	...	...	...	...	...	...	...	...	...	...
Bute - - -	...	...	...	...	...	...	...	...	...	...	...
Caithness - - -	...	...	...	...	...	...	...	...	...	...	...
Clackmannan - -	...	...	...	...	...	...	...	...	...	...	...
Cromarty - - -	...	...	...	...	...	...	...	...	...	...	...
Dumbarton - -	...	1	1	...	...	...	2	...	1	...	1
Dumfries - - -	...	...	...	...	...	...	...	...	...	...	...
Edinburgh - -	...	...	...	...	...	...	...	...	...	...	...
Elgin, or Moray - -	...	...	...	...	...	...	...	...	...	...	...
Fife - - -	...	...	...	...	...	...	...	...	...	...	...
Forfar - - -	...	...	...	...	...	...	...	...	...	...	...
Haddington - -	...	...	...	...	...	...	...	...	...	...	...
Inverness - - -	...	...	...	...	...	...	...	...	...	...	...
Kincardine - -	...	...	...	...	...	...	...	...	...	...	...
Kinross - - -	...	...	...	...	...	...	...	...	...	...	...
Kirkcudbright - -	...	...	...	...	...	...	...	...	...	...	...
Lanark - - -	1	30	31	...	...	...	38	38	...	...	...
Linlithgow - -	...	...	...	...	...	...	...	...	...	...	...
Nairn - - -	...	...	...	...	...	...	...	...	...	...	...
Orkney - - -	...	...	...	...	...	...	...	...	...	...	...
Peebles - - -	...	...	...	...	...	...	...	...	...	...	...
Perth - - -	...	...	...	...	...	...	...	...	...	...	...
Renfrew - - -	...	4	4	...	...	...	8	7	1	...	...
Ross - - -	...	...	...	...	...	...	...	...	...	...	...
Roxburgh - - -	...	...	...	...	...	...	...	...	...	...	...
Selkirk - - -	...	...	...	...	...	...	...	...	...	...	...
Shetland - - -	...	...	...	...	...	...	...	...	...	...	...
Stirling - - -	...	1	1	...	...	...	1	...	...	1	...
Sutherland - -	...	...	...	...	...	...	...	...	...	...	...
Wigtown - - -	...	1	1	...	...	...	1	1	...	...	...

in each County, in *each Week*, see Table XXIII. ; and for the Numbers Killed and Died, Table XXIV.
Proportion per Cent. which the Numbers Attacked bear to the Total Number of Horses in Great Britain in each Year, see Table IX.
For the Number of Horses *Attacked* in *each Week* of the Year 1874, in England, in Wales, in Scotland, and in Great Britain respectively, see 1874, see Table XI.

† Including 1 Mule.

TABLE

Table showing the Number of **Horses** reported, by the Inspectors of the Local Authorities, to have been
Year

Counties.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.*																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	1	.	.	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Derby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dorset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	7	5	7	.	.	.	.	.	.	.	.	.	1	.	.	.
Essex	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	1	.	.	3	.	.	.	.
Gloucester	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	1	.	.	1	.	.	1	.	.	.	.	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.
Huntingdon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kent (ex. Metropolis)	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.
Lancaster	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	†1	.	.	.	.	.
Leicester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	.	1	.	.	.	.	.	1	.	1	.	1	1	.	.	.	.	.	.	.	1	1	.	.	.	2
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.
Norfolk	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.
Somerset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Stafford	.	1	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1
Suffolk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	1	1	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sussex	1	1	1	1	.	.	.	1	.	.	.	.	.	.	1	.	1	.	.	.	.	1	.	.	.	.
Warwick	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	.	.	.	.	2	1
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" North "	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" West "	.	.	.	.	.	.	.	.	1	1	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	2	5	3	1	4	2	6	2	5	4	2	10	1	2	3	12	6	1	.	4	1	3	6	6	7	9
WALES.*																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.*																										
Aberdeen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fife	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	4	2	2	.	1	4	.	1	.	.	3	1	1	1	2	.	1	.	.	.	1	.	.	2	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	4	.	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Horses Attacked with the Disease, in each County, during the Year,
* For the Numbers Attacked, in each Week, in England,
† This animal was a Mule.

XXIII.

ATTACKED with GLANDERS, in each County of GREAT BRITAIN, during each Week of the 1874.*

ENDING																										COUNTIES.
July				August					September				October					November				December				
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cumberland.
.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
.	.	.	.	.	2	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
1	3	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	3	.	3	.	.	.	.	1	.	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	Gloucester.
1	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
1	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Huntingdon.
.	.	1	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	Kent (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
1	.	2	1	3	.	1	.	.	.	.	.	.	5	.	.	.	.	.	2	.	.	.	1	.	.	Middlesex (ex. Metropolis).
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	Monmouth.
.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	1	.	.	.	.	.	.	.	.	.	.	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Somerset.
.	1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	.	Stafford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	Suffolk.
.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sussex.
.	.	.	.	.	1	.	.	.	.	1	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wilts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	.	1	.	.	.	2	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ North „
.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Liberty of St. Albans.
1	4	6	5	10	8	9	7	8	4	6	4	4	3	2	6	3	7	12	5	7	3	8	6	11	3	The Metropolis.
																										WALES.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	.	.	.	1	1	.	2	.	.	.	.	.	2	.	1	2	2	1	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

see Table XXII.; and for the Number Attacked in *Great Britain*, in *each Week*, see Table XXV.
in Wales, and in Scotland respectively, see Table XII.

TABLE

TABLE showing the Number of HORSES reported, by the Inspectors of the Local Authorities, to have been during each Week

COUNTIES.	WEEKS																								
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	1	.	.	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Derby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dorset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	.	.	.	.	.	.	.	.	‡6	2	7	2	.	1	.	.	.	.	.	.	.	1	.	.
Essex	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	2	.	.	.
Gloucester	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	*1	.	.	.	.	*1	.	.	.	1	.	1	.	.	1	.	.	.	.	.	.	.	.	*1	.
Huntingdon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kent (ex. Metropolis)	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	3	.	.	.	1	.	.	.	.	.	.
Lancaster	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	§1	.	.	.	.	.
Leicester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	.	.	2	.	.	.	.	.	1	.	.	.	†2	1	.	.	.	.	.	.	.	.	.	*1	.	2
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.
Norfolk	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.
Somerset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	.	.
Stafford	.	1	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1
Suffolk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	1	1	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sussex	4	.	2	1	.	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	.
Warwick	.	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	1	.	.	.	.	.	.	.	2	1
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" North "	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" West "	.	.	.	.	.	.	.	.	1	*1	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	5	2	‡5	1	†4	*1	7	1	5	5	1	11	1	1	4	10	5	3	1	5	.	3	6	7	5	8
WALES.																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	*1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.																										
Aberdeen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fife	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	4	2	2	.	1	4	.	1	.	.	3	1	1	1	2	.	1	.	.	.	1	.	.	2	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	*1	.	3	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Horses Killed and Died while suffering from the Disease, in each County,

* These animals died. † Including 1 died.

XXIV.

KILLED and to have **DIED** while suffering from **GLANDERS,** in each County of GREAT BRITAIN of the Year 1874.

ENDING																										COUNTIES.
July				August					September				October					November				December				
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cumberland.
.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
.	.	.	.	.	1	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
1	3	.	.	.	1	.	.	.	1	.	.	.	.	.	1	.	2	.	3	.	1	.	.	1	.	Essex.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	.	3	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Huntingdon.
.	.	1	.	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Kent (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	.	.	.	.	.	.	.	.	*1	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	,, ,, Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	,, ,, Lindsey.
1	.	3	1	4	.	1	.	.	.	.	.	.	3	1	1	.	.	.	1	1	.	.	1	.	.	Middlesex (ex. Metropolis).
.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	.	.	.	.	Monmouth.
.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Somerset.
.	1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	3	2	.	.	.	Stafford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Suffolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sussex.
.	.	.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wilts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*1	1	.	.	.	7	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	,, North ,,
.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	,, West ,,
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	Liberty of St. Albans.
2	5	6	4	10	6	†10	6	7	3	3	5	4	7	6	6	3	6	11	5	7	5	†6	7	12	†2	The Metropolis.
																										WALES.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Aberdeen.
.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	.	.	.	1	1	.	2	.	.	.	.	.	1	1	1	2	2	1	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

during the Year, see Table XXII. ; and for the Number Killed and Died in *Great Britain*, in *each Week*, see Table XXV.

‡ Including 2 died.

§ This animal was a Mule, and was killed.

TABLE XXV.

TABLE showing the PROGRESS of **GLANDERS** in GREAT BRITAIN during the Year 1874; compiled from the Weekly Returns received from the Inspectors of the Local Authorities, and corrected in accordance with subsequent correspondence.

Weeks ending	Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Total Number of Farms or other Places upon which the Disease existed in each Week.	Healthy Horses on infected Premises.		Attacked.		Diseased Horses.			
				Slaughtered.	Removed.	Remaining diseased from the previous Week.	Attacked in each Week.	Killed.	Died.	Recovered.	Remaining diseased at the end of each Week.
January 3	10	9	18	...	...	25	10	15	...	...	20
,, 10	11	10	20	...	...	20	12	7	1	...	24
,, 17	10	7	21	1	...	24	10	12	3	...	19
,, 24	8	2	11	...	...	19	4	3	...	...	20
,, 31	9	6	14	...	...	20	6	5	1	4	16
February 7	8	6	14	...	...	16	6	4	1	6	11
,, 14	7	8	14	...	...	11	8	8	1	...	10
,, 21	11	9	16	...	...	10	11	3	1	...	17
,, 28	13	8	21	...	...	17	8	10	...	...	15
March 7	12	7	20	...	...	15	8	10	1	...	12
,, 14	11	7	19	...	...	12	15	12	2	...	13
,, 21	11	9	22	...	...	13	19	15	...	...	17
,, 28	11	7	20	...	...	17	12	13	1	1	14
April 4	12	5	19	...	...	14	6	7	...	1	12
,, 11	12	4	17	...	...	12	6	7	...	...	11
,, 18	11	13	22	...	...	11	18	15	...	...	14
,, 25	14	11	23	...	...	14	12	10	...	...	16
May 2	12	3	17	...	...	16	4	5	...	...	15
,, 9	13	2	14	...	...	15	2	2	...	...	15
,, 16	13	5	17	...	...	15	5	8	1	...	11
,, 23	14	8	16	...	...	11	*8	*4	...	...	15
,, 30	13	7	19	...	...	15	9	5	...	...	19
June 6	13	9	23	...	...	19	9	10	...	...	18
,, 13	13	8	22	...	...	18	8	10	1	2	13
,, 20	10	8	17	...	...	13	10	7	1	...	15
,, 27	9	12	22	...	...	15	13	12	...	...	16
July 4	10	5	16	...	...	16	5	5	...	1	15
,, 11	10	8	19	...	...	15	9	10	...	...	14
,, 18	10	9	19	...	...	14	11	14	...	...	11
,, 25	7	6	14	...	...	11	9	9	...	...	11
August 1	7	12	20	...	...	11	14	14	...	...	11
,, 8	11	12	20	...	...	11	14	11	...	...	14
,, 15	11	14	24	...	...	14	14	16	1	...	11
,, 22	8	8	16	...	...	11	9	8	...	...	12
,, 29	8	7	15	...	...	12	11	9	...	...	14
September 5	8	6	13	...	...	14	7	6	...	...	15
,, 12	8	10	17	...	...	15	12	10	...	...	17
,, 19	10	8	17	...	...	17	9	6	...	...	20
,, 26	10	4	15	...	...	20	6	6	1	...	19
October 3	9	8	19	...	...	19	9	10	1	1	16
,, 10	10	4	17	...	...	16	5	11	...	1	9
,, 17	11	10	21	...	...	9	18	14	...	1	12
,, 24	6	3	11	...	...	12	3	4	1	...	10
,, 31	8	11	17	...	1	10	13	10	1	...	12
November 7	6	11	17	...	...	12	14	13	...	...	13
,, 14	10	12	20	...	...	13	16	13	...	...	16
,, 21	11	9	20	...	...	16	12	9	1	...	18
,, 28	10	5	17	...	...	18	8	18	...	...	8
December 5	7	5	12	...	...	8	9	8	1	...	8
,, 12	5	6	12	2	...	8	7	8	...	...	7
,, 19	6	9	15	...	...	7	12	13	...	...	6
,, 26	10	9	14	...	...	6	12	3	2	1	12
Total -	—	401	—	3	1	† —	*507	*477	24	19	‡—

Note.—For the *Aggregate Results* in *each County*, see Table XXII. For the Number Attacked in *each County*, in each Week, see Table XXIII.; and for the Numbers Killed and Died, Table XXIV.

* Including 1 Mule.

† 25 Horses were remaining diseased from the previous year.

‡ 12 Horses were remaining diseased at the end of the year.

TABLE XXVI.

TABLE showing the PROGRESS of **FARCY** in GREAT BRITAIN during the Year 1874; compiled from the Weekly Returns received from the Inspectors of the Local Authorities, and corrected in accordance with subsequent correspondence.

Weeks ending	Number of Counties reported from.	Number of Farms or other Places upon which Fresh Outbreaks took place.	Total Number of Farms or other Places upon which the Disease existed in each Week.	Healthy Horses on infected Premises.		Attacked.		Diseased Horses.			
				Slaughtered.	Removed.	Remaining diseased from the previous Week.	Attacked in each Week.	Killed.	Died.	Recovered.	Remaining diseased at the end of each Week.
January 3	4	1	5	...	...	3	2	1	...	...	4
„ 10	7	5	9	...	...	4	7	2	...	...	9
„ 17	7	...	7	...	...	9	...	3	...	1	5
„ 24	7	3	8	...	...	5	3	2	...	...	6
„ 31	8	5	11	...	...	6	6	...	...	1	11
February 7	7	1	11	...	...	11	1	2	1	3	6
„ 14	5	1	7	...	...	6	1	2	...	1	4
„ 21	8	4	8	...	...	4	4	1	...	1	6
„ 28	6	2	8	...	...	6	2	3	...	...	5
March 7	5	...	5	...	...	5	...	1	...	1	3
„ 14	4	1	4	...	...	3	2	...	...	1	4
„ 21	3	...	3	...	...	4	...	...	...	...	4
„ 28	3	...	3	...	...	4	...	...	...	...	4
April 4	4	1	4	...	...	4	1	...	...	...	5
„ 11	4	...	4	...	...	5	...	...	...	1	4
„ 18	6	4	7	...	...	4	4	4	...	1	3
„ 25	4	1	4	...	...	3	1	1	...	...	3
May 2	3	...	3	...	...	3	...	...	...	1	2
„ 9	5	3	5	...	...	2	3	2	...	1	2
„ 16	4	2	4	...	...	2	2	1	...	...	3
„ 23	5	3	6	...	...	3	3	...	2	1	3
„ 30	5	2	5	...	...	3	2	1	...	...	4
June 6	4	...	4	...	...	4	...	...	...	...	4
„ 13	4	...	4	...	...	4	...	...	...	1	3
„ 20	5	6	9	...	...	3	6	3	1	...	5
„ 27	4	1	6	...	...	5	1	3	...	...	3
July 4	5	3	6	...	...	3	3	2	1	...	3
„ 11	3	1	4	...	...	3	1	1	...	...	3
„ 18	4	5	8	...	...	3	5	3	...	1	4
„ 25	4	2	6	...	...	4	2	3	...	...	3
August 1	3	1	5	...	...	3	1	2	...	1	1
„ 8	2	2	4	...	...	1	2	1	...	...	2
„ 15	4	3	6	...	...	2	3	2	...	...	3
„ 22	5	4	7	...	...	3	4	3	...	...	4
„ 29	3	4	8	...	...	4	4	2	1	1	4
September 5	3	2	6	...	...	4	3	3	...	1	3
„ 12	4	4	8	...	...	3	4	3	...	...	4
„ 19	2	4	9	...	...	4	4	6	...	1	1
„ 26	3	4	6	...	...	1	4	2	...	...	3
October 3	4	2	6	...	...	3	2	3	...	...	2
„ 10	5	5	8	...	...	2	6	5	1	...	2
„ 17	5	3	6	...	...	2	3	2	...	...	3
„ 24	5	1	6	...	...	3	1	2	1	...	1
„ 31	3	1	4	...	...	1	1	...	...	...	2
November 7	5	4	7	...	1	2	5	3	...	...	4
„ 14	4	3	7	...	...	4	3	1	2	...	4
„ 21	6	4	8	...	...	4	4	4	...	...	4
„ 28	4	2	6	...	...	4	2	4	...	...	2
December 5	6	6	9	...	...	2	6	3	...	1	4
„ 12	5	1	6	...	...	4	1	3	...	...	2
„ 19	4	1	4	...	...	2	1	1	1	...	1
„ 26	5	3	6	...	...	1	3	1	...	...	3
Total	—	121	—	...	1	*—	129	97	11	21	†—

Note.—For the *Aggregate Results* in *each County*, see Table XXVII. For the Number Attacked in *each County*, in each Week, see Table XXVIII.; and for the Numbers Killed and Died, Table XXIX.

* 3 Horses were remaining diseased from the previous year.

† 3 Horses were remaining diseased at the end of the year.

TABLE

NUMBER of FARMS or other PLACES in the COUNTIES of GREAT BRITAIN upon which Fresh Outbreaks
Year 1874; with the Number of Horses reported to have been Attacked,

COUNTIES, &c.	Number of Counties reported from.	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Horses on infected premises.		Attacked.		Diseased Horses.			
					Slaughtered.	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
GREAT BRITAIN*	21	4	121	125	...	1	3	129	97	11	21	3
ENGLAND*	19	4	113	117	...	1	3	121	90	11	20	3
WALES*	...	...	...	...	...	...	...	...	...	...	...	...
SCOTLAND*	2	...	8	8	...	...	...	8	7	...	1	...
ENGLAND.												
Bedford		...	...	...	...	...	...	...	...	...	...	...
Berks		...	...	...	...	...	...	...	...	...	...	...
Buckingham		...	...	...	...	...	...	...	...	...	...	...
Cambridge (ex. Liberty of I. of Ely)		...	...	...	...	...	...	...	...	...	...	...
Chester		...	1	1	...	...	...	1	...	...	1	...
Cornwall		...	1	1	...	...	...	1	...	...	1	...
Cumberland		...	...	...	...	...	...	...	...	...	...	...
Derby		...	...	...	...	...	...	...	...	...	...	...
Devon		...	...	...	...	...	...	...	...	...	...	...
Dorset		...	1	1	...	...	...	1	1	...	...	...
Durham		...	2	2	...	...	...	4	3	...	1	...
Essex		...	6	6	...	...	...	6	2	2	1	1
Gloucester		...	2	2	...	...	...	2	2	...	...	...
Hants		...	...	...	...	...	...	...	...	...	...	...
Hereford		...	...	...	...	...	...	...	...	...	...	...
Hertford (ex. Liberty of St. Albans)		1	5	6	...	...	1	5	5	...	1	...
Huntingdon		...	...	...	...	...	...	...	...	...	...	...
Kent (ex. Metropolis)		...	7	7	...	...	...	7	4	1	1	1
Lancaster		...	...	...	...	...	...	...	...	...	...	...
Leicester		...	...	...	...	...	...	...	...	...	...	...
Lincoln, Parts of Holland		...	...	...	...	...	...	...	...	...	...	...
,, ,, Kesteven		...	...	...	...	...	...	...	...	...	...	...
,, ,, Lindsey		...	...	...	...	...	...	...	...	...	...	...
Middlesex (ex. Metropolis)		1	9	10	...	...	1	10	6	2	3	...
Monmouth		...	2	2	...	...	...	2	...	2	...	...
Norfolk		...	3	3	...	...	...	3	1	1	1	...
Northampton (ex. Soke of Peterbro')		...	...	...	...	...	...	...	...	...	...	...
Northumberland		...	...	...	...	...	...	...	...	...	...	...
Notts		...	...	...	...	...	...	...	...	...	...	...
Oxford		...	...	...	...	...	...	...	...	...	...	...
Rutland		...	...	...	...	...	...	...	...	...	...	...
Salop		1	1	2	...	...	1	1	...	...	2	...
Somerset		...	...	...	...	...	...	...	...	...	...	...
Stafford		...	...	...	...	...	...	...	...	...	...	...
Suffolk		...	5	5	...	...	...	5	...	...	5	...
Surrey (ex. Metropolis)		...	2	2	...	...	...	3	2	...	1	...
Sussex		...	1	1	...	...	...	1	1	...	...	...
Warwick		...	1	1	...	...	...	1	1	...	...	...
Westmorland		...	...	...	...	...	...	...	...	...	...	...
Wilts		...	1	1	...	...	...	1	1	...	...	...
Worcester		...	1	1	...	...	...	1	1	...	...	...
York, East Riding		...	...	...	...	...	...	...	...	...	...	...
,, North ,,		...	...	...	...	...	...	...	...	...	...	...
,, West ,,		...	...	...	...	...	...	...	...	...	...	...

Note.—For the *Weekly Progress* of the Disease in Great Britain, see Table XXVI. For the Numbers

* For the *Results* of the Disease in Great Britain in *each of the Years 1873 and 1874*, see Table VIII. For the *Proportion per Cent.* per Cent. of the Number of Diseased Horses Killed, Died, and Recovered respectively, in each Year, see Table X. For the Number of and for the *Proportion per Cent.* of the Number of Diseased Horses Killed, Died, and Recovered respectively, in the Year 1874, see

XXVII.

of **FARCY** were reported, by the Inspectors of the Local Authorities, to have occurred, during the to have been Killed, to have Died, and to have Recovered.

Counties (*continued*).	Number of Farms or other Places upon which the Disease was existing at the end of the previous Year.	Number of Farms or other Places upon which Fresh Outbreaks took place during the Year.	Total Number of Farms or other Places upon which the Disease existed during the Year.	Healthy Horses on infected Premises.		Attacked.		Diseased Horses.			
				Slaughtered.	Removed.	Remaining diseased from the previous Year.	Attacked since.	Killed.	Died.	Recovered.	Remaining.
ENGLAND—*cont.*											
Liberty of the Isle of Ely	...	...	...	...	...	...	...	...	...	...	...
Soke of Peterborough	...	...	...	...	...	...	...	...	...	...	...
Liberty of St. Albans	...	...	...	...	...	...	...	...	...	...	...
The Metropolis	1	62	63	...	1	...	66	60	3	2	1
WALES.											
Anglesey	...	...	...	...	...	...	...	...	...	...	...
Brecon	...	...	...	...	...	...	...	...	...	...	...
Cardigan	...	...	...	...	...	...	...	...	...	...	...
Carmarthen	...	...	...	...	...	...	...	...	...	...	...
Carnarvon	...	...	...	...	...	...	...	...	...	...	...
Denbigh	...	...	...	...	...	...	...	...	...	...	...
Flint	...	...	...	...	...	...	...	...	...	...	...
Glamorgan	...	...	...	...	...	...	...	...	...	...	...
Merioneth	...	...	...	...	...	...	...	...	...	...	...
Montgomery	...	...	...	...	...	...	...	...	...	...	...
Pembroke	...	...	...	...	...	...	...	...	...	...	...
Radnor	...	...	...	...	...	...	...	...	...	...	...
SCOTLAND.											
Aberdeen	...	...	...	...	...	...	...	...	...	...	...
Argyll	...	1	1	...	...	...	1	...	...	1	...
Ayr	...	...	...	...	...	...	...	...	...	...	...
Banff	...	...	...	...	...	...	...	...	...	...	...
Berwick	...	...	...	...	...	...	...	...	...	...	...
Bute	...	...	...	...	...	...	...	...	...	...	...
Caithness	...	...	...	...	...	...	...	...	...	...	...
Clackmannan	...	...	...	...	...	...	...	...	...	...	...
Cromarty	...	...	...	...	...	...	...	...	...	...	...
Dumbarton	...	...	...	...	...	...	...	...	...	...	...
Dumfries	...	...	...	...	...	...	...	...	...	...	...
Edinburgh	...	...	...	...	...	...	...	...	...	...	...
Elgin, or Moray	...	...	...	...	...	...	...	...	...	...	...
Fife	...	...	...	...	...	...	...	...	...	...	...
Forfar	...	...	...	...	...	...	...	...	...	...	...
Haddington	...	...	...	...	...	...	...	...	...	...	...
Inverness	...	...	...	...	...	...	...	...	...	...	...
Kincardine	...	...	...	...	...	...	...	...	...	...	...
Kinross	...	...	...	...	...	...	...	...	...	...	...
Kirkcudbright	...	...	...	...	...	...	...	...	...	...	...
Lanark	...	7	7	...	...	...	7	7	...	...	...
Linlithgow	...	...	...	...	...	...	...	...	...	...	...
Nairn	...	...	...	...	...	...	...	...	...	...	...
Orkney	...	...	...	...	...	...	...	...	...	...	...
Peebles	...	...	...	...	...	...	...	...	...	...	...
Perth	...	...	...	...	...	...	...	...	...	...	...
Renfrew	...	...	...	...	...	...	...	...	...	...	...
Ross	...	...	...	...	...	...	...	...	...	...	...
Roxburgh	...	...	...	...	...	...	...	...	...	...	...
Selkirk	...	...	...	...	...	...	...	...	...	...	...
Shetland	...	...	...	...	...	...	...	...	...	...	...
Stirling	...	...	...	...	...	...	...	...	...	...	...
Sutherland	...	...	...	...	...	...	...	...	...	...	...
Wigtown	...	...	...	...	...	...	...	...	...	...	...

Attacked, in each County, *in each Week*, see Table XXVIII.; and for the Numbers Killed and Died, Table XXIX.
which the Numbers Attacked bear to the Total Number of Horses in Great Britain in each Year, see Table IX.; and for the Proportion
Horses *Attacked* in *each Week* of the Year 1874, in England, in Wales, in Scotland, and in Great Britain, respectively, see Table XII.;
Table XI.

TABLE

TABLE showing the NUMBER of HORSES reported, by the Inspectors of the Local Authorities, to have been Year

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.*																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Derby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dorset	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Essex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Hants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Huntingdon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kent (ex. Metropolis)	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	2	.
Lancaster	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leicester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" " Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Somerset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stafford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Suffolk	.	1	.	1	1	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sussex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" North "	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
" West "	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	2	2	.	2	4	1	1	.	2	.	.	.	.	.	.	1	1	.	1	1	1	1	.	.	4	1
WALES.*																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.*																										
Aberdeen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fife	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Horses Attacked with the Disease, in each County, during the Year,

* For the Numbers Attacked in each Week, in England,

XXVIII.

ATTACKED with **FARCY,** in each County of GREAT BRITAIN, during each Week of the 1874.

ENDING																										
July				August					September				October					November				December				COUNTIES.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
.	.	.	.	.	.	1	.	.	.	.	.	1	.	1	.	.	.	.	1	.	.	1	.	.	.	Essex.
.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Huntingdon.
.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	Kent (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
.	.	1	1	.	.	1	.	1	2	1	.	1	.	.	.	.	.	.	.	.	1	.	.	.	.	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	.	.	.	Monmouth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Somerset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stafford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Suffolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	Sussex.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	Wilts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ North „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of St. Albans.
2	1	4	.	1	2	.	1	3	.	2	4	2	1	3	2	1	1	2	1	1	1	3	.	1	2	The Metropolis.
																										WALES.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.*
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Moray.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	1	.	.	1	1	.	.	.	.	.	1	1	.	.	.	1	.	1	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

see Table XXVII; and for the Number Attacked in *Great Britain,* in *each Week,* see Table XXVI.
in Wales, and in Scotland respectively, see Table XII.

TABLE

TABLE showing the Number of HORSES reported, by the Inspectors of the Local Authorities, to have been during each Week

COUNTIES.	WEEKS																									
	January					February				March				April				May					June			
	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
ENGLAND.																										
Bedford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berks	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Buckingham	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cambridge (ex. Liberty of Isle of Ely)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornwall	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Derby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Devon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dorset	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Durham	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Essex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gloucester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Hants	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hereford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hertford (ex. Liberty of St. Albans)	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Huntingdon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kent (ex. Metropolis)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	†2	.
Lancaster	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leicester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lincoln, Parts of Holland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
,, ,, Kesteven	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
,, ,, Lindsey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Middlesex (ex. Metropolis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Monmouth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Norfolk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	*1	.	.	.	.	.
Northampton (ex. Soke of Peterboro')	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Northumberland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Notts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rutland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salop	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Somerset	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stafford	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Suffolk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Surrey (ex. Metropolis)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Sussex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Westmorland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wilts	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Worcester	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
York, East Riding	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
,, North ,,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
,, West ,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of the Isle of Ely	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Soke of Peterborough	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Liberty of St. Albans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
The Metropolis	1	2	1	2	.	†3	1	.	3	.	.	.	.	.	.	1	1	.	1	1	*1	1	.	.	2	3
WALES																										
Anglesey	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brecon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardigan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carmarthen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carnarvon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Denbigh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flint	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glamorgan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Merioneth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Montgomery	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pembroke	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Radnor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
SCOTLAND.																										
Aberdeen	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Argyll	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ayr	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Banff	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Berwick	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bute	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caithness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clackmannan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cromarty	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumbarton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dumfries	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Edinburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elgin, or Moray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fife	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Forfar	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Haddington	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Inverness	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kincardine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kinross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kirkcudbright	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lanark	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linlithgow	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nairn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orkney	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peebles	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perth	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Renfrew	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ross	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Roxburgh	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Selkirk	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Shetland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stirling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sutherland	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Wigtown	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Note.—For the *Total Number* of Horses Killed and Died while suffering from the Disease, in each County,

* These animals died.

XXIX.

KILLED and to have DIED while suffering from FARCY, in each County of GREAT BRITAIN of the Year 1874.

ENDING																										
July				August					September				October					November				December				COUNTIES.
4	11	18	25	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	
																										ENGLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bedford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berks.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Buckingham.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cambridge (ex. Liberty of Isle of Ely).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Chester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cornwall.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Derby.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Devon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dorset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Durham.
.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	*1	.	.	*1	.	.	.	.	.	.	Essex.
.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Gloucester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hants.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Hereford.
1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	Hertford (ex. Liberty of St. Albans).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Huntingdon.
.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	Kent (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lancaster.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Leicester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Lincoln, Parts of Holland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Kesteven.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ „ Lindsey.
*1	.	.	1	.	.	.	.	*1	2	.	.	.	1	.	.	.	.	.	.	.	1	.	1	.	.	Middlesex (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	*1	.	.	.	.	*1	.	Monmouth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Norfolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northampton (ex. Soke of Peterboro').
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Northumberland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Notts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Oxford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Rutland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Salop.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Somerset.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stafford.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Suffolk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	Surrey (ex. Metropolis).
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	Sussex.
.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Warwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Westmorland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	Wilts.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	Worcester.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	York, East Riding.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ North „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	„ West „
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of the Isle of Ely.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Soke of Peterborough.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Liberty of St. Albans.
1	1	3	1	2	1	.	1	1	1	1	6	2	1	†3	2	1	.	2	.	2	2	2	1	1	1	The Metropolis.
																										WALES.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Anglesey.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Brecon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cardigan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carmarthen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Carnarvon.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Denbigh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Flint.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Glamorgan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Merioneth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Montgomery.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Pembroke.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Radnor.
																										SCOTLAND.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Aberdeen.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Argyll.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ayr.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Banff.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Berwick.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Bute.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Caithness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Clackmannan.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Cromarty.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumbarton.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Dumfries.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Edinburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Elgin, or Mora
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Fife.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Forfar.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Haddington.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Inverness.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kincardine.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kinross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Kirkcudbright.
.	.	.	1	.	.	1	1	.	.	.	.	.	1	1	.	.	.	1	.	1	.	.	.	.	.	Lanark.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Linlithgow.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Nairn.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Orkney.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Peebles.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Perth.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Renfrew.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Ross.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Roxburgh.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Selkirk.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Shetland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Stirling.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Sutherland.
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	Wigtown.

during the Year, see Table XXVII.; and for the Number Killed and Died in *Great Britain*, in *each Week*, see Table XXVI,

† Including 1 died.

TABLE XXX.

COMPARATIVE TABLE showing the NUMBER of ANIMALS (and of CARCASES) returned as having been received by HORSE SLAUGHTERERS and FAT MELTERS in, or near the METROPOLIS, for the purpose of being DESTROYED, during the Years 1870, 1871, 1872, 1873, and 1874; showing the cause of DEATH or of SLAUGHTER, and distinguishing the Home from the Foreign Animals.

——	YEARS.	Cattle Plague.	Pleuro-Pneumonia.	Foot-and-Mouth Disease.	Sheep-Pox.	Sheep-Scab.	Glanders.	Farcy.	Other Diseases.	Injuries, Exhaustion, and Suffocation.	Unknown	TOTAL.
HOME Animals	1870	...	1	2	...	...	111	69	170	19	49	421
	1871	...	10	1	...	...	92	31	57	10	5	206
	1872	...	1	1	...	...	167	37	37	9	4	256
	1873	...	13	1	...	...	195	29	30	2	2	272
	1874	...	6	1	...	...	261	60	33	5	4	370
FOREIGN Animals*	1870	...	...	...	...	...	...	...	...	...	...	...
	1871	...	5	...	...	...	...	...	6	96	...	107
	1872	...	...	...	...	...	...	...	1	57	...	58
	1873	...	...	...	...	...	...	...	1	247	4	252
	1874	...	...	...	...	...	...	...	...	143	...	143
TOTAL	1870	...	1	2	...	...	111	69	170	19	49	421
	1871	...	15	1	...	...	92	31	63	106	5	313
	1872	...	1	1	...	...	167	37	38	66	4	314
	1873	...	13	1	...	...	195	29	31	249	6	524
	1874†	...	6	1	...	...	261	60	33	148	4	513

* The Foreign Animals either died, or were landed dead, or were slaughtered, at the place of landing.
† See Table XXXI. for the detailed Return of 1874.

TABLE XXXI.

NUMBER of ANIMALS (and of CARCASES) returned as having been received by HORSE SLAUGHTERERS and FAT MELTERS in, or near the METROPOLIS, for the purpose of being DESTROYED, during the Year 1874; showing the cause of DEATH or of SLAUGHTER.

CAUSE OF DEATH OR OF SLAUGHTER.	Bulls.	Cows.	Oxen.	Heifers.	Calves.	TOTAL CATTLE.	SHEEP.	SWINE.	HORSES.	TOTAL ANIMALS.
Cattle Plague - - -	...	...	...	...	...	...	...	...	...	...
Pleuro-Pneumonia - -	...	6	...	...	...	6	...	...	...	6
Foot-and-Mouth Disease -	...	1	...	...	...	1	...	...	...	1
Sheep-Pox - - -	...	...	...	...	...	...	...	...	...	...
Sheep-Scab - - -	...	...	...	...	...	...	...	...	...	...
Glanders - - -	...	...	...	...	...	...	...	...	261	261
Farcy - - -	...	...	...	...	...	...	...	...	60	60
Other Diseases - -	...	19	1	2	...	22	...	...	11	33
Injuries, Exhaustion, and Suffocation - - -	...	4	3*	1 3*	...	5 6*	122*	15*	...	5 143*
Unknown - - - -	...	3	...	1	...	4	...	...	...	4
TOTAL - -	...	33	1—3* 4	4—3* 7	...	38—6* 44	122*	15*	332	370—143* 513

Note.—See Table XXX. for Summary of 1870, 1871, 1872, 1873, and 1874.
* These were Foreign Animals, which were either landed dead, or slaughtered, or which died, at the place of landing.

TABLE XXXII.

NUMBER of CATTLE, SHEEP, and SWINE Imported into GREAT BRITAIN from IRELAND, during each of the Years 1870, 1871, 1872, 1873, and 1874.

YEARS.	CATTLE.			Sheep and Lambs.	Swine.	TOTAL ANIMALS.
	Oxen, Bulls, and Cows.	Calves.	TOTAL.			
1870 - -	415,673	38,296	453,969	620,834	422,076	1,496,879
1871 - -	423,396	60,529	483,925	684,708	528,244	1,696,877
1872* - -	481,878	134,202	616,080	518,606	443,644	1,578,330
1873† - -	...	...	684,618	604,695	364,371	1,653,684
1874† - -	509,330	41,879	551,209	744,234	344,335	1,639,778

Note.—For the Numbers Imported into Great Britain from *Foreign Countries*, see Table XXXIII.

* From a Return furnished by Professor Ferguson, of the Dublin Veterinary Department.

† From Returns furnished to the Irish Government by Professor Ferguson. (Professor Ferguson remarks that these figures are approximate.)

TABLE XXXIII.

NUMBER of CATTLE, SHEEP, and SWINE Imported into GREAT BRITAIN from FOREIGN COUNTRIES, during each of the Years 1870, 1871, 1872, 1873, and 1874. (*See Note.*)

YEARS.	CATTLE.				SHEEP.			SWINE.	TOTAL ANIMALS.
	Oxen and Bulls.	Cows.	Calves.	TOTAL.	Sheep.	Lambs.	TOTAL.	TOTAL.	
1870	145,002	25,050	31,738	201,790	654,079	18,760	672,839	97,259	971,888
1871	134,259	73,051	40,116	247,426	...	...	†917,077	85,613	1,250,116
1872	109,562	28,928	33,506	171,996	...	...	†810,539	16,058	998,593
1873	119,384	36,342	43,242	198,968	...	...	†849,278	79,923	1,128,169
1874*	119,173	37,954	35,969	193,096	...	...	†756,924	115,314	1,065,334

Note.—For the Numbers Imported from the *Channel Islands*, see Table XLV.; and from *Ireland*, Table XXXII. For the Numbers of Cattle, Sheep, and Swine from *each Country*, in each Year, see Table XXXVI.; for the Numbers landed at *each Port* of Great Britain in each Year, see Table XXXV.; for the *Proportion per Cent.* of *Diseased* to Total Number of Foreign Animals Imported in each Year, see Table LI.; and for the *Average Value*, per Head, of Foreign Animals Imported in each Year, see Table XL.

* For the Numbers of Cattle, Sheep, and Swine from *each Country* to *each British Port*, in the Year 1874, see Table XXXVII.

† The Sheep and Lambs have not been distinguished in the Returns furnished by Her Majesty's Customs since 1870.

TABLE XXXIV.

NUMBER of CATTLE, SHEEP, and SWINE Imported into LONDON from FOREIGN COUNTRIES, during each of the Years 1870, 1871, 1872, 1873, and 1874, and the Proportion per Cent. which such Number bears to the Total Importation into Great Britain.

YEARS.	CATTLE.		SHEEP.		SWINE.	
	Number.	Proportion per Cent.	Number.	Proportion per Cent.	Number.	Proportion per Cent.
1870 - -	125,267	62·078	380,864	56·606	29,736	30·574
1871 - -	120,964	48·889	590,935	64·437	31,925	37·290
1872 - -	98,732	57·404	632,422	78·025	8,629	53·736
1873 - -	100,583	50·552	542,508	63·879	23,512	29·418
1874* - -	113,251	58·650	506,056	66·857	53,975	46·807

Note.—For the Numbers of Cattle, Sheep, and Swine landed at *each Wharf* of the Port of London, in each of the above Years, see Table XXXVIII.

* For the Numbers of Cattle, Sheep, and Swine landed at *each Wharf* of the Port of London, from *each Country*, in the year 1874, see Table XXXIX.

TABLE

NUMBER of CATTLE, SHEEP, and SWINE Imported into each PORT of GREAT BRITAIN from

PORTS.	YEARS.	Cattle.	Sheep.	Swine.	TOTAL ANIMALS.	PORTS (*continued*).	YEARS.	Cattle.	Sheep.	Swine.	TOTAL ANIMALS.
Barrow-in-Furness.	1870	...	...	...	...	Grangemouth -	1870	...	...	...	...
	1871	...	...	...	...		1871	...	730	...	730
	1872	...	...	...	...		1872	...	...	...	...
	1873	...	...	...	...		1873	...	5,333	...	5,333
	1874	...	...	...	...		1874	...	...	...	...
Bristol - -	1870	2	1	79	82	Granton -	1870	4	...	...	4
	1871	...	1	87	88		1871	479	647	19	1,145
	1872	...	3	59	62		1872	880	2,828	143	3,851
	1873	...	8	77	85		1873	775	...	54	829
	1874	...	6	77	83		1874	195	...	...	195
Cardiff - -	1870	...	...	...	...	Grimsby -	1870	109	11,725	12,234	24,068
	1871	124	...	...	124		1871	1,818	11,509	10,808	24,135
	1872	1	2	...	3		1872	39	3,014	474	3,527
	1873	...	...	...	...		1873	...	2,307	2,102	4,409
	1874	...	...	...	...		1874	...	297	4,684	4,981
Dartmouth -	1870	...	...	...	...	Hartlepool -	1870	3,106	28,998	2,001	34,105
	1871	...	...	2	2		1871	4,875	30,922	4,119	39,916
	1872	...	...	...	...		1872	2,833	15,534	449	18,816
	1873	...	...	...	...		1873	3,967	29,082	1,713	34,762
	1874	...	...	...	...		1874	2,577	23,777	1,581	27,935
Dover - -	1870	...	...	...	...	Harwich -	1870	124	161,786	20,202	182,112
	1871	...	...	...	...		1871	25,451	141,354	19,827	186,632
	1872	...	...	...	...		1872	9,112	57,665	1,404	68,181
	1873	...	8	387	395		1873	11,318	144,513	5,979	161,810
	1874	...	...	37	37		1874	10,537	135,668	7,002	153,207
Falmouth -	1870	5,762	290	...	6,052	Hull - -	1870	19,934	22,048	7,992	49,974
	1871	3,168	...	...	3,168		1871	34,522	30,720	5,925	71,167
	1872	2,958	...	...	2,958		1872	17,427	27,086	916	45,429
	1873	3,271	...	...	3,271		1873	22,661	15,378	7,340	45,379
	1874	4,167	351	...	4,518		1874	18,200	7,958	14,331	40,489
Folkestone -	1870	...	...	...	...	Kirkwall -	1870	14	...	...	14
	1871	...	...	...	...		1871	81	1	...	82
	1872	...	...	...	...		1872	70	1	...	71
	1873	...	...	...	...		1873	24	1	...	25
	1874	...	...	...	...		1874	54	...	...	54
Glasgow -	1870	151	...	16	167	Leith - -	1870	3,900	10,370	701	14,971
	1871	340	...	28	368		1871	9,650	12,372	386	22,408
	1872	223	...	26	249		1872	8,063	12,682	47	20,792
	1873	650	2	8	660		1873	10,572	6,349	383	17,304
	1874	29	...	15	44		1874	8,355	3,989	39	12,383
Goole - -	1870	123	77	2,954	3,154	Littlehampton -	1870	534	...	12	546
	1871	553	1,406	161	2,120		1871	80	...	...	80
	1872	117	...	...	117		1872	...	...	...	...
	1873	308	2	24	334		1873	1	...	479	480
	1874	178	5	...	183		1874	...	...	39	39

Note.—For the Numbers Imported into each Port of Great Britain, from the *Channel Islands*, in the Years 1872, 1873, and 1874, see Table
For the Numbers Imported into each British Port from *each*

For the Number of *Diseased* Animals landed at each Port in each of the Years 1870, 1871, 1872, 1873, and 1874, see Table XLVII.; and
For the *Proportion per Cent.* which the Numbers landed at each Port bear to the Total

* Foreign Animals may not now be landed at these Ports.

† These two Sheep were landed at Dundee by

XXXV.

FOREIGN COUNTRIES, during each of the Years 1870, 1871, 1872, 1873, and 1874. (*See Note.*)

PORTS (*continued*).	YEARS.	Cattle.	Sheep.	Swine.	TOTAL ANIMALS.
Liverpool	1870	13,724	5,470	588	19,782
	1871	7,311	8,181	575	16,067
	1872	6,694	11,325	467	18,486
	1873	7,634	13,216	256	21,106
	1874	6,030	992	210	7,232
Llanelly *	1870	1	...	...	1
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
London	1870	125,267	380,864	29,736	535,867
	1871	120,964	590,935	31,925	743,824
	1872	98,732	632,422	8,629	739,783
	1873	100,583	542,508	23,512	666,603
	1874	113,251	506,056	53,975	673,282
Middlesbrough	1870	1,039	5,673	425	7,137
	1871	2,388	9,524	903	12,815
	1872	983	16,470	3	17,456
	1873	1,212	11,323	986	13,521
	1874	563	6,519	1,083	8,165
Newcastle-upon-Tyne	1870	4,219	35,290	2,352	41,861
	1871	10,838	39,783	6,090	56,711
	1872	9,697	27,834	523	38,054
	1873	15,493	46,663	2,275	64,431
	1874	16,828	42,525	3,847	63,200
Newhaven	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	243	243
	1874	...	4	98	102
Penzance	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
Plymouth	1870	6,239	78	135	6,452
	1871	6,997	17	...	7,014
	1872	4,679	1	...	4,680
	1873	4,270	4	...	4,274
	1874	4,545	5	...	4,550
Portsmouth	1870	6,246	654	5,425	12,325
	1871	4,645	3	813	5,461
	1872	3,214	4	16	3,234
	1873	7,043	7	14,983	22,033
	1874	3,379	15	11,300	14,694

PORTS (*continued*).	YEARS.	Cattle.	Sheep.	Swine.	TOTAL ANIMALS.
Scilly*	1870	4	...	...	4
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
Shields, North	1870	...	...	1	1
	1871	...	...	...	...
	1872	183	2	...	185
	1873	...	...	...	...
	1874	...	1	...	
Shields, South	1870	...	...	22	22
	1871	...	34	...	34
	1872	23	...	7	30
	1873	224	25	16	265
	1874	...	...	16	16
Shoreham	1870	178	53	...	231
	1871	...	2	...	2
	1872	267	205	...	472
	1873	...	...	65	65
	1874	...	...	236	236
Southampton	1870	11,110	827	11,857	23,794
	1871	13,135	59	885	14,079
	1872	5,582	390	2,888	8,860
	1873	8,893	321	18,830	28,044
	1874	4,164	294	16,735	21,193
Sunderland	1870	...	8,635	494	9,129
	1871	7	38,877	3,060	41,944
	1872	219	3,069	7	3,295
	1873	69	31,358	211	31,638
	1874	44	28,462	9	28,515
Weymouth	1870	...	...	33	33
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
——	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	†2	...	†2
	1873	...	‡870	...	‡870
	1874	...	...	...	...

XLV. For the *Total Numbers* Imported into Great Britain from *Foreign Countries* during each of the above Years, see Table XXXIII.
Foreign Country during the Year 1874, see Table XXXVII.
for the Number of *Diseased* and *Injured* Animals landed in the Year 1874, see Table LV. for London, and Table LVI. for the other Ports.
Importation into Great Britain, in each of the above Years, see Table XLIII.
special permission of the Privy Council.

‡ These Sheep were landed at Aberdeen during the Year 1873.

TABL

RETURN of the Number of CATTLE, SHEEP, and SWINE IMPORTED into GREAT BRITAI

YEARS.	BELGIUM.			DENMARK.			FRANCE.			GERMANY.			NETHERLANDS.			NORWAY.	
	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.
1870 - -	991	133,627	14,021	8,063	6,388	1,286	6,861	3,178	17,876	53,656	206,117	18,824	76,323	322,272	44,098	2	5
1871 - -	301	104,394	2,099	16,411	13,402	3,018	...	24	1,709	77,144	491,927	36,045	106,186	304,417	41,850	1,020	2,129
1872 - -	...	60,678	1	18,307	17,249	700	683	21,797	2,954	55,698	472,634	1,286	58,286	229,734	9,871	1,454	5,061
1873 - -	280	150,933	1,357	27,630	20,331	7,099	742	8,293	40,997	59,891	394,476	4,493	59,168	267,704	24,179	2,218	3,453
1874* - -	1,086	108,193	1,552	26,800	14,456	7,330	2,145	2,105	42,442	57,368	305,186	13,527	66,606	324,488	49,740	1,121	168

Note.—For the Numbers of *Oxen*, *Cows*, and *Calves*, Imported into Great Britain during these five Years, see Table XXXIII. For the *Proportion pe*
* For the Numbers landed at *each Port* of Great Britain, from each Foreign Country in the Year 1874, se

TABL

RETURN of the Number of CATTLE, SHEEP, and SWINE IMPORTED into GREAT BRITAIN, showi

PORTS in GREAT BRITAIN at which Foreign Animals might be landed.	BELGIUM.			DENMARK.			FRANCE.			GERMANY.			NETHERLANDS.			NORWAY.	
	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.
Barrow-in-Furness -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bristol - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cardiff - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dartmouth - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dover - -	...	...	...	...	...	...	...	...	37	...	...	...	...	...	...	...	...
Falmouth - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Folkestone - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Glasgow - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Goole - - -	119	...	...	...	...	...	...	5	...	...	...	...	59	...	...	...	...
Grangemouth -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Granton - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	138	...
Grimsby - -	...	...	...	...	...	...	...	...	188	...	297	3,001	...	...	1,486	...	...
Hartlepool - -	...	...	...	...	...	...	...	...	...	1,537	23,339	1,260	...	...	...	...	...
Harwich - -	...	55,000	342	...	...	...	...	...	...	...	...	...	10,537	80,668	6,660	...	...
Hull - -	70	...	...	488	1,600	4,904	...	...	55	6,716	5,362	5,209	10,505	824	4,153	420	168
Kirkwall - -	...	...	...	54	...	...	...	...	...	...	...	...	...	...	...	...	...
Leith - - -	...	...	...	7,901	2,388	39	...	...	...	...	1,589	...	454	...	...	...	...
Littlehampton -	...	...	...	...	...	...	...	...	39	...	...	...	...	...	...	...	...
Liverpool - -	...	...	...	...	...	...	...	...	2	...	960	...	...	...	...	...	...
London* - -	877	53,192	1,208	3,173	614	8	1,508	1,804	13,751	47,041	206,123	1,695	45,006	242,982	37,271	563	...
Middlesbrough -	...	...	...	...	...	...	...	...	...	549	6,519	1,083	...	...	...	...	...
Newcastle-upon-Tyne	20	...	...	15,181	9,853	2,379	...	...	...	1,525	32,574	1,279	45	14	168	...	...
Newhaven - -	...	...	...	...	...	...	...	4	98	...	...	...	...	...	...	...	...
Penzance - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plymouth - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Portsmouth - -	...	...	...	3	1	...	...	...	11,300	...	...	...	...	...	...	...	...
Shields, North -	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shields, South -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shoreham - -	...	...	...	...	...	...	...	...	236	...	...	...	...	...	...	...	...
Southampton -	...	...	...	...	...	...	637	292	16,735	...	...	...	...	...	...	...	...
Sunderland - -	...	...	2	...	...	...	...	...	1	...	28,423	...	...	...	2	...	...
Weymouth - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL - -	1,086	108,193	1,552	26,800	14,456	7,330	2,145	2,105	42,442	57,368	305,186	13,527	66,606	324,488	49,740	1,121	168

Note.—For the Number landed at each British Port in *each of the Years from 1870 to 1874 inclusive*, see Table XXXV., and for the Number receiv
Port, see Table XLIX. For the *Proportion per Cent.* which the Number from each Foreign Country
* For the Numbers landed at *each Wh*

XXVI.

n each Country, during the Years 1870, 1871, 1872, 1873, and 1874.

PORTUGAL.			RUSSIA.			SPAIN.			SWEDEN.			OTHER COUNTRIES.			TOTAL.			YEARS.
attle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	CATTLE.	SHEEP.	SWINE.	
387	7	42	79	...	36	27,002	80	237	4,760	810	280	166	355	557	201,790	672,839	97,259	- - 1870.
462	37	8	270	60	44	19,984	30	13	5,615	633	131	33	24	655	247,426	917,077	85,613	- - 1871.
372	87	7	693	1	32	15,389	15	6	7,073	3,248	646	41	35	534	171,996	810,539	16,058	- - 1872.
398	176	38	...	...	7	19,511	210	10	12,192	3,671	1,410	438	31	333	198,968	849,278	79,923	- - 1873.
412	4	61	...	...	25	16,509	113	4	8,704	1,799	381	345	412	262	193,096	756,924	115,314	- - 1874.*

Cent. which the Numbers received from each Country bear to the Total Importation into Great Britain, in each of the above Years, see Table XLII.
Table XXXVII. For the *Average Value*, per Head, of Animals received from each Country, see Table XLI.

XXVII.

Countries from which received, and the Ports at which landed, during the Year 1874.

PORTUGAL.			RUSSIA.			SPAIN.			SWEDEN.			OTHER COUNTRIES.			TOTAL.			PORTS in GREAT BRITAIN at which Foreign Animals might be landed.
Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	CATTLE.	SHEEP.	SWINE.	
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Barrow-in-Furness.
..	...	...	...	...	13	...	...	1	...	...	1	...	6	62	...	6	77	Bristol.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Cardiff.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Dartmouth.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	37	Dover.
..	...	...	...	...	...	4,099	...	...	...	...	...	68	351	...	4,167	351	...	Falmouth.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Folkestone.
29	...	...	...	...	...	...	...	...	...	...	...	...	...	15	29	...	15	Glasgow.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	178	5	...	Goole.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Grangemouth.
..	...	...	...	...	...	...	...	...	57	...	...	...	...	...	195	...	...	Granton.
..	...	...	...	...	6	...	...	...	...	...	2	...	...	1	...	297	4,684	Grimsby.
..	...	...	...	...	3	...	...	...	1,040	438	316	...	...	2	2,577	23,777	1,581	Hartlepool.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10,537	135,668	7,002	Harwich.
1	4	8	...	...	1	...	...	...	...	...	...	...	...	1	18,200	7,958	14,331	Hull.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	54	...	...	Kirkwall.
..	...	...	...	...	...	...	...	...	...	...	...	...	12	...	8,355	3,989	39	Leith.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	39	Littlehampton.
598	...	53	...	...	...	2,157	...	3	...	...	...	275	32	152	6,030	992	210	Liverpool.
473	...	...	...	...	...	2,118	103	...	7,492	1,238	42	...	...	...	113,251	506,056	53,975	London.*
..	...	...	...	...	...	...	...	...	14	...	...	...	...	...	563	6,519	1,083	Middlesbrough.
..	...	...	...	...	...	...	...	...	57	84	20	...	...	1	16,828	42,525	3,847	Newcastle-upon-Tyne.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	98	Newhaven.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Penzance.
..	...	...	...	...	...	4,545	5	...	...	...	...	...	...	...	4,545	5	...	Plymouth.
..	...	...	...	...	...	3,374	5	...	...	...	...	2	9	...	3,379	15	11,300	Portsmouth.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	Shields, North.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...	...	16	Shields, South.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	236	Shoreham.
311	...	...	...	...	...	216	...	...	...	...	...	...	2	...	4,164	294	16,735	Southampton.
..	...	...	...	...	2	...	...	...	44	39	...	...	...	2	44	28,462	9	Sunderland.
..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Weymouth.
,412	4	61	...	...	25	16,509	113	4	8,704	1,799	381	345	412	252	193,096	756,924	115,314	TOTAL.

m each Foreign Country in the same Years, see Table XXXVI. For the Number of *Diseased* Animals from each Foreign Country to each British
h British Port, bears to the Total Importation into Great Britain, see Table XLIV.
the Port of *London*, see Table XXXIX.

TABLE XXXVIII.

NUMBER of FOREIGN CATTLE, SHEEP, and SWINE landed at each WHARF of the PORT of LONDON to which such ANIMALS were brought, during each of the Years 1870, 1871, 1872, 1873, and 1874.

DESCRIPTION of ANIMALS.	YEARS.	Brown's Wharf.	Brunswick Wharf.	Deptford Victualling Yard.	Foreign Cattle Market.	Fresh Wharf.	Odams's Wharf.	St. Katherine's Wharf.	Thames Haven.	Victoria Docks.	TOTAL.
CATTLE -	1870	20,115	110	1,045	...	6	21,560	...	82,149	...	†124,985
	1871	24,202	...	...	...	...	7,626	...	89,368	95	†121,291
	1872	5,162	...	...	38,426	...	434	...	54,710	...	98,732
	1873	17,560	...	...	7,090	...	...	...	75,933	...	100,583
	1874*	23,094	...	...	7,175	...	...	...	82,982	...	113,251
SHEEP -	1870	215,106	28,451	383	...	66	41,856	...	91,947	125	†377,934
	1871	256,602	...	...	...	...	112,011	...	222,949	412	†591,974
	1872	266,401	1,075	...	122,601	...	1,442	...	240,903	...	632,422
	1873	319,422	310	...	2,339	...	...	...	220,437	...	542,508
	1874*	312,808	...	...	114	...	...	...	193,134	...	506,056
SWINE -	1870	18,614	235	...	...	...	2,070	24	8,699	...	†29,642
	1871	16,672	...	...	...	...	1,412	...	13,858	...	†31,942
	1872	3,416	...	...	173	...	...	...	5,040	...	8,629
	1873	9,851	...	...	394	...	...	...	13,267	...	23,512
	1874*	17,772	224	...	16,955	...	...	1	19,023	...	53,975
TOTAL ANIMALS -	1870	253,835	28,796	1,428	...	72	65,486	24	182,795	125	†532,561
	1871	297,476	...	...	...	...	121,049	...	326,175	507	†745,207
	1872	274,979	1,075	...	161,200	...	1,876	...	300,653	...	739,783
	1873	346,833	310	...	9,823	...	...	...	309,637	...	666,603
	1874	353,674	224	...	24,244	...	...	1	295,139	...	673,282

* For the Numbers of Cattle, Sheep, and Swine from each *Foreign Country* to each Wharf of the Port of London in the Year 1874, see Table XXXIX. For the Numbers of *Diseased and Injured* Foreign Animals landed at the Port of London in each of the above Years, see Table LIV.

† The Numbers entered in the last column for the Years 1870 and 1871 do not exactly tally with those given in the other Tables, being compiled from a different source of information. They may, however, be considered as practically correct for the purposes of this Table.

TABLE XXXIX.

RETURN of the NUMBER of CATTLE, SHEEP, and SWINE IMPORTED into LONDON, showing the Countries from which received, and the Wharves at which landed, during the Year 1874.

COUNTRIES.	BROWN'S WHARF.			BRUNSWICK WHARF.			FOREIGN CATTLE MARKET.			THAMES HAVEN.			ST. KATHERINE'S WHARF.			TOTAL.		
	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	CATTLE.	SHEEP.	SWINE.
Belgium - -	...	53,192	1,050	...	...	...	877	...	158	...	...	...	...	...	...	877	53,192	1,208
Denmark - -	...	...	...	...	...	...	...	...	...	3,173	614	8	...	...	...	3,173	614	8
France - -	...	1,690	8,272	...	...	47	1,508	114	123	...	...	5,308	...	...	1	1,508	1,804	13,751
Germany - -	16,799	112,626	1,431	...	...	...	2,305	...	264	27,937	93,497	...	...	...	...	47,041	206,123	1,695
Netherlands - -	5,820	145,300	7,019	...	...	177	112	...	16,410	39,074	97,682	13,665	...	...	...	45,006	242,982	37,271
Norway - -	...	...	...	...	...	...	...	...	...	563	...	...	...	...	...	563	...	...
Portugal - -	40	...	...	...	...	...	2,373	...	...	3,060	...	...	...	...	...	5,473	...	...
Russia - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spain - -	435	...	...	...	...	...	...	...	...	1,683	103	...	...	...	...	2,118	103	...
Sweden - -	...	...	...	...	...	...	...	...	...	7,492	1,238	42	...	...	...	7,492	1,238	42
Other Countries -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL - -	23,094	312,808	17,772	...	...	224	7,175	114	16,955	82,982	193,134	19,023	...	...	1	113,251	506,056	53,975

Note.—For the Number landed at each Wharf of the Port of London in *each of the Years from 1870 to 1874 inclusive*, see Table XXXVIII. For the Number of *Diseased and Injured* Animals landed at the Port of London in 1874, see Table LV.

TABLE XL.

Average Value, per Head, of Foreign Cattle, Sheep, and Swine Imported into the United Kingdom, in each of the Years 1870, 1871, 1872, 1873, and 1874. (*See Note.*)

Years.	Cattle.			Sheep (*including Lambs*).	Swine.
	Oxen, Bulls, and Cows.	Calves.	All Cattle.		
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
1870 - -	17 13 3	4 4 5	15 11 4	1 14 4	3 14 7
1871 - -	16 10 2	3 10 0	14 8 2	1 19 0	3 8 0
1872 - -	18 7 7	3 7 4	15 9 5	2 1 2	3 4 1
1873 - -	19 18 9	4 19 0	16 14 1	2 2 10	2 19 9
1874* - -	19 16 2	4 14 8	17 0 1	2 2 5	3 2 1

Note.—Calculated upon the Total Number and Value of the Animals Imported, as given in the "Annual Statement of the Trade and Navigation of the United Kingdom with Foreign Countries and British Possessions" for the Year 1870, published by the Board of Trade, and in the "Annual Statement of the Trade of the United Kingdom with Foreign Countries and British Possessions" for the Year 1871 and the Year 1872, published by Her Majesty's Customs. The data for 1873 and 1874 have been furnished by Her Majesty's Customs.

For the *Numbers* of Cattle, Sheep, and Swine Imported into Great Britain in each of the above Years, see Table XXXIII.

* For the Average Value, per Head, of Foreign Cattle, Sheep, and Swine Imported into the United Kingdom *from each Country*, in the Year 1874, See Table XLI.

TABLE XLI.

Average Value, per Head, of Foreign Cattle, Sheep, and Swine Imported into the United Kingdom from each Country, in the Year 1874.

(*Calculated upon information furnished by Her Majesty's Customs.*)

Countries.	Cattle.			Sheep (*including Lambs*).	Swine.
	Oxen, Bulls, and Cows.	Calves.	All Cattle.		
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
Belgium - - -	21 15 3	...	21 15 3	2 7 0	3 4 6
Denmark - - -	18 16 10	4 15 7	18 13 0	2 2 10	4 7 4
France - - -	23 10 4	5 12 9	23 5 1	3 8 8	3 0 4
Germany - - -	19 19 9	4 16 1	19 19 5	1 17 11	3 12 0
Netherlands - -	20 1 9	4 14 6	12 3 9	2 5 0	2 17 1
Norway - - -	17 15 1	*1 0 0	17 14 9	2 0 0	...
Portugal - - -	21 1 11	...	21 1 11	2 10 0	4 7 10
Russia - - -	...	...	...	...	†1 6 5
Spain - - -	18 15 5	5 0 0	18 15 4	2 2 8	3 0 0
Sweden - - -	19 14 0	4 19 1	17 14 0	2 0 7	2 19 6
Other Countries -	19 2 11	...	19 2 11	2 1 0	2 13 7
All Countries -	19 16 2	4 14 8	17 0 1	2 2 5	3 2 1

Note.—For the Average Value, per Head, of Foreign Cattle, Sheep, and Swine Imported into the United Kingdom, *in each of the Years from 1870 to 1874 inclusive*, see Table XL.

For the *Numbers* of Cattle, Sheep, and Swine Imported into Great Britain, from each Country, in the Year 1874, see Table XXXVI.

* Only 1 Calf was received from Norway during the Year, the animal being a young one, and not worth more than 1*l.*

† The Swine received from Russia were few in number, and, as some of them were Sucking Pigs, the Average Value was comparatively low.

TABLE XLII.

TABLE showing the **PROPORTION PER CENT.** which the Number of FOREIGN CATTLE, SHEEP, and SWINE **received from each COUNTRY,** bears to the Total Number Imported into GREAT BRITAIN, in each of the Years 1870, 1871, 1872, 1873, and 1874.

DESCRIPTION OF ANIMALS.	YEARS.	BELGIUM.	DENMARK.	FRANCE.	GERMANY.	NETHERLANDS.	NORWAY.	PORTUGAL.	RUSSIA.	SPAIN.	SWEDEN.	OTHER COUNTRIES.
CATTLE - -	1870	·491	3·996	3·400	26·590	37·823	·001	11·838	·039	13·381	2·359	·082
	1871	·122	6·633	...	31·179	42·916	·412	8·270	·109	8·077	2·269	·013
	1872	...	10·644	·397	32·383	33·888	·846	8·356	·403	8·947	4·112	·024
	1873	·141	13·887	·373	30·101	29·737	1·115	8·493	...	9·806	6·127	·220
	1874	·562	13·879	1·111	29·709	34·494	·580	6·428	...	8·550	4·508	·179
SHEEP - -	1870	19·860	·950	·472	30·634	47·897	·001	·001	...	·012	·120	·053
	1871	11·383	1·461	·003	53·641	33·194	·232	·004	·007	·003	·069	·003
	1872	7·486	2·128	2·689	58·311	28·343	·625	·011	·000	·002	·401	·004
	1873	17·772	2·394	·976	46·448	31·521	·407	·021	...	·025	·432	·004
	1874	14·294	1·910	·278	40·319	42·869	·022	·001	...	·015	·238	·054
SWINE - -	1870	14·416	1·322	18·380	19·354	45·341	·002	·043	·037	·244	·288	·573
	1871	2·452	3·525	1·996	42·102	48·883	·048	·009	·052	·015	·153	·765
	1872	·006	4·359	18·396	8·009	61·471	·131	·044	·199	·037	4·023	3·325
	1873	1·698	8·882	51·296	5·622	30·253	...	·047	·009	·012	1·764	·417
	1874	1·346	6·357	36·805	11·730	43·135	...	·053	·022	·003	·330	·219
ALL ANIMALS -	1870	15·294	1·619	2·872	28·665	45·550	·001	2·463	·012	2·811	·602	·111
	1871	8·543	2·626	·139	48·405	36·193	·255	1·640	·030	1·602	·510	·057
	1872	6·076	3·631	2·547	53·036	29·831	·655	1·449	·073	1·543	1·098	·061
	1873	13·524	4·880	4·435	40·673	31·117	·502	1·517	·001	1·749	1·531	·071
	1874	10·404	4·561	4·383	35·301	41·380	·121	1·171	·002	1·560	1·022	·095

Note.—For the Proportion per Cent. of the Number of Cattle, Sheep, and Swine *landed at each British Port,* in each of the above Years, see Table XLIII. For the *Number* received from each Foreign Country, see Table XXXVI. For the Proportion per Cent. of the Number of Cattle, Sheep, and Swine *landed at each Port of Great Britain from each Foreign Country* in the Year 1874, see Table XLIV.

TABLE

TABLE showing the **PROPORTION PER CENT.** which the Number of FOREIGN CATTLE, SHEEP, in each of the Years 1870,

PORTS.	YEARS.	PROPORTION PER CENT.				PORTS (*continued*).	YEARS.	PROPORTION PER CENT.			
		Cattle.	Sheep.	Swine.	ALL ANIMALS.			Cattle.	Sheep.	Swine.	ALL ANIMALS.
Barrow - in - Furness -	1870	...	...	...	...	Grangemouth -	1870	...	...	...	...
	1871	...	...	...	...		1871	...	·080	...	·058
	1872	...	...	...	...		1872	...	...	...	...
	1873	...	...	...	...		1873	...	·628	...	·473
	1874	...	...	...	...		1874	...	...	...	...
Bristol - -	1870	·001	·000	·081	·009	Granton -	1870	·002	...	...	·001
	1871	...	·000	·101	·007		1871	·194	·071	·022	·092
	1872	...	·001	·367	·006		1872	·512	·349	·890	·386
	1873	...	·001	·097	·008		1873	·389	...	·068	·073
	1874	...	·001	·067	·008		1874	·101	...	...	·018
Cardiff -	1870	...	...	...	...	Grimsby -	1870	·054	1·743	12·579	2·476
	1871	·050	...	...	·010		1871	·735	1·255	12·624	1·931
	1872	·001	·000	...	·000		1872	·023	·372	2·952	·353
	1873	...	...	...	...		1873	...	·272	2·630	·391
	1874	...	...	...	...		1874	...	·039	4·062	·468
Dartmouth -	1870	...	...	...	...	Hartlepool -	1870	1·539	4·310	2·057	3·509
	1871	...	...	·002	·000		1871	1·970	3·372	4·811	3·193
	1872	...	...	...	...		1872	1·647	1·916	2·796	1·884
	1873	...	...	...	...		1873	1·994	3·424	2·143	3·081
	1874	...	...	...	...		1874	1·335	3·141	1·371	2·622
Dover - -	1870	...	...	...	...	Harwich -	1870	·061	24·045	20·771	18·738
	1871	...	...	...	...		1871	10·286	15·413	23·159	14·929
	1872	...	...	...	...		1872	5·298	7·114	8·743	6·828
	1873	...	·001	·484	·035		1873	5·688	17·016	7·481	14·343
	1874	...	...	·032	·003		1874	5·457	17·924	6·072	14·381
Falmouth -	1870	2·855	·043	...	·623	Hull - -	1870	9·878	3·277	8·217	5·142
	1871	1·280	...	...	·253		1871	13·953	3·350	6·921	5·693
	1872	1·720	...	...	·296		1872	10·132	3·342	5·704	4·549
	1873	1·644	...	...	·290		1873	11·389	1·811	9·184	4·022
	1874	2·158	·046	...	·424		1874	9·425	1·051	12·428	3·801
Folkestone -	1870	...	...	...	...	Kirkwall -	1870	·007	...	...	·002
	1871	...	...	...	...		1871	·033	·000	...	·007
	1872	...	...	...	...		1872	·041	·000	...	·007
	1873	...	...	...	...		1873	·012	·000	...	·002
	1874	...	...	...	...		1874	·028	...	...	·005
Glasgow - -	1870	·075	...	·017	·017	Leith -	1870	1·933	1·541	·721	1·540
	1871	·137	...	·033	·029		1871	3·900	1·349	·451	1·793
	1872	·130	...	·162	·025		1872	4·688	1·565	·293	2·082
	1873	·327	·000	·010	·058		1873	5·313	·748	·479	1·584
	1874	·015	...	·013	·004		1874	4·327	·527	·034	1·162
Goole - -	1870	·061	·011	3·037	·325	Littlehampton -	1870	·265	...	·012	·056
	1871	·224	·153	·188	·170		1871	·032	...	...	·006
	1872	·068	...	...	·012		1872	...	...	...	...
	1873	·155	·000	·030	·030		1873	·001	...	·599	·043
	1874	·092	·001	...	·018		1874	...	...	·034	·004

Note.—For the Proportion per Cent. of the Number of Cattle, Sheep, and Swine *from each Foreign Country*, in each of the above Years, Cattle, Sheep, and Swine *landed at each Port of Great Britain from*

* Foreign Animals may not now be landed at these Ports.

† This represents 2 Sheep that were landed at

XLIII.

and SWINE **landed at each PORT,** bears to the Total Number Imported into GREAT BRITAIN, 1871, 1872, 1873, and 1874.

PORTS (*continued*).	YEARS.	PROPORTION PER CENT.			
		Cattle.	Sheep.	Swine.	ALL ANIMALS.
Liverpool	1870	6·801	·813	·605	2·035
	1871	2·955	·892	·672	1·285
	1872	3·892	1·397	2·908	1·851
	1873	3·837	1·556	·320	1·871
	1874	3·123	·131	·182	·679
Llanelly *	1870	·001	...	...	·000
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
London	1870	62·078	56·606	30·574	55·137
	1871	48·889	64·437	37·290	59·500
	1872	57·404	78·025	53·736	74·083
	1873	50·552	63·879	29·418	59·087
	1874	58·650	66·857	46·807	63·199
Middlesbrough	1870	·515	·843	·437	·734
	1871	·965	1·038	1·055	1·025
	1872	·571	2·032	·019	1·748
	1873	·609	1·333	1·234	1·198
	1874	·291	·861	·939	·767
Newcastle-upon-Tyne	1870	2·091	5·245	2·418	4·307
	1871	4·380	4·338	7·113	4·537
	1872	5·638	3·434	3·257	3·811
	1873	7·787	5·494	2·847	5·711
	1874	8·715	5·618	3·336	5·932
Newhaven	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	·304	·022
	1874	...	·001	·085	·009
Penzance	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
Plymouth	1870	3·092	·012	·139	·664
	1871	2·828	·002	...	·561
	1872	2·720	·000	...	·469
	1873	2·146	·001	...	·379
	1874	2·354	·001	...	·427
Portsmouth	1870	3·095	·097	5·578	1·268
	1871	1·877	·001	·950	·437
	1872	1·869	·001	·100	·324
	1873	3·540	·001	18·747	1·953
	1874	1·749	·002	9·799	1·380
Scilly *	1870	·002	...	...	·001
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
Shields, North	1870	...	...	·001	·000
	1871	...	...	...	...
	1872	·106	·000	...	·019
	1873	...	...	...	...
	1874	...	·000	...	·000
Shields, South	1870	...	...	·023	·002
	1871	...	·004	...	·003
	1872	·013	...	·044	·003
	1873	·113	·003	·020	·023
	1874	...	...	·014	·002
Shoreham	1870	·088	·008	...	·024
	1871	...	·000	...	·000
	1872	·155	·025	...	·047
	1873	...	...	·081	·006
	1874	...	...	·205	·022
Southampton	1870	5·506	·123	12·191	2·448
	1871	5·309	·006	1·034	1·126
	1872	3·245	·048	17·985	·887
	1873	4·469	·038	23·560	2·486
	1874	2·157	·039	14·512	1·989
Sunderland	1870	...	1·283	·508	·939
	1871	·003	4·239	3·574	3·355
	1872	·127	·379	·044	·330
	1873	·035	3·692	·264	2·804
	1874	·023	3·760	·008	2·676
Weymouth	1870	...	...	·034	·003
	1871	...	...	...	...
	1872	...	...	...	...
	1873	...	...	...	...
	1874	...	...	...	...
——	1870	...	...	...	...
	1871	...	...	...	...
	1872	...	†·000	...	†·000
	1873	...	‡·102	...	‡·077
	1874	...	...	...	...

see Table XLII. For the *Number* landed at each British Port, see Table XXXV. For the Proportion per Cent. of the Number of *each Foreign Country* in the Year 1874, see Table XLIV.

Dundee by special permission of the Privy Council. ‡ This represents 870 Sheep that were landed at Aberdeen during the Year 1873.

TABLE

TABLE showing the **PROPORTION PER CENT.** which the Number of FOREIGN CATTLE, SHEEP, and
Number Imported into GREAT

CATTLE.

BRITISH PORT.	Belgium.	Denmark.	France.	Germany.	Netherlands.	Norway.	Portugal.	Russia.	Spain.	Sweden.	Other Countries.	ALL COUNTRIES.
Barrow-in-Furness	...	...	...	...	...	...	...	...	...	...	...	...
Bristol	...	...	...	...	...	...	...	...	...	...	...	...
Cardiff	...	...	...	...	...	...	...	...	...	...	...	...
Dartmouth	...	...	...	...	...	...	...	...	...	...	...	...
Dover	...	...	...	...	...	...	...	...	...	...	...	...
Falmouth	...	...	...	...	...	...	...	...	2·123	...	·035	2·158
Folkestone	...	...	...	...	...	...	...	...	...	...	...	...
Glasgow	...	...	...	...	...	...	·015	...	...	...	...	·015
Goole	·062	...	...	...	·030	...	...	...	...	...	...	·092
Grangemouth	...	...	...	...	...	...	...	...	...	...	...	...
Granton	...	...	...	...	...	·071	...	...	...	·030	...	·101
Grimsby	...	...	...	...	...	...	...	...	...	...	...	...
Hartlepool	...	...	...	·796	...	...	...	...	...	·539	...	1·335
Harwich	...	...	...	...	5·457	...	...	...	...	...	...	5·457
Hull	·036	·253	...	3·478	5·440	·217	·001	...	...	...	...	9·425
Kirkwall	...	·028	...	...	...	...	...	...	...	...	...	·028
Leith	...	4·092	...	...	·235	...	...	...	...	...	...	4·327
Littlehampton	...	...	...	...	...	...	...	...	...	...	...	...
Liverpool	...	...	...	...	...	...	1·863	...	1·117	...	·143	3·123
London	·454	1·643	·781	24·361	23·308	·292	2·834	...	1·097	3·880	...	58·650
Middlesbrough	...	...	...	·284	...	...	...	...	...	·007	...	·291
Newcastle-upon-Tyne	·010	7·862	...	·790	·024	...	...	...	...	·029	...	8·715
Newhaven	...	...	...	...	...	...	...	...	...	...	...	...
Penzance	...	...	...	...	...	...	...	...	...	...	...	...
Plymouth	...	...	...	...	...	...	...	...	2·354	...	...	2·354
Portsmouth	...	·001	...	...	...	...	...	...	1·747	...	·001	1·749
Shields, North	...	...	...	...	...	...	...	...	...	...	...	...
Shields, South	...	...	...	...	...	...	...	...	...	...	...	...
Shoreham	...	...	...	...	...	...	...	...	...	...	...	...
Southampton	...	...	·330	...	...	...	1·715	...	·112	...	...	2·157
Sunderland	...	...	...	...	...	...	...	...	...	·023	...	·023
Weymouth	...	...	...	...	...	...	...	...	...	...	...	...
GREAT BRITAIN	·562	13·879	1·111	29·709	34·494	·580	6·428	...	8·550	4·508	·179	100·000

SHEEP.

BRITISH PORT.	Belgium.	Denmark.	France.	Germany.	Netherlands.	Norway.	Portugal.	Russia.	Spain.	Sweden.	Other Countries.	ALL COUNTRIES.
Barrow-in-Furness	...	...	...	...	...	...	...	...	...	...	...	...
Bristol	...	...	...	...	...	...	...	...	...	...	·001	·001
Cardiff	...	...	...	...	...	...	...	...	...	...	...	...
Dartmouth	...	...	...	...	...	...	...	...	...	...	...	...
Dover	...	...	...	...	...	...	...	...	...	...	...	...
Falmouth	...	...	...	...	...	...	...	...	...	...	·046	·046
Folkestone	...	...	...	...	...	...	...	...	...	...	...	...
Glasgow	...	...	...	...	...	...	...	...	...	...	...	...
Goole	...	...	·001	...	...	...	...	...	...	...	...	·001
Grangemouth	...	...	...	...	...	...	...	...	...	...	...	...
Granton	...	...	...	...	...	...	...	...	...	...	...	...
Grimsby	...	...	...	·039	...	...	...	...	...	...	...	·039
Hartlepool	...	...	...	3·083	...	...	...	...	...	·058	...	3·141
Harwich	7·267	...	...	...	10·657	...	...	...	...	...	...	17·924
Hull	...	·211	...	·708	·109	·022	·001	...	...	...	...	1·051
Kirkwall	...	...	...	...	...	...	...	...	...	...	...	...
Leith	...	·316	...	·210	...	...	...	...	...	...	·001	·527
Littlehampton	...	...	...	...	...	...	...	...	...	...	...	...
Liverpool	...	...	...	·127	...	...	...	...	...	...	·004	·131
London	7·027	·081	·238	27·232	32·102	...	...	...	·013	·164	...	66·857
Middlesbrough	...	...	...	·861	...	...	...	...	...	...	...	·861
Newcastle-upon-Tyne	...	1·302	...	4·304	·001	...	...	...	...	·011	...	5·618
Newhaven	...	...	·001	...	...	...	...	...	...	...	...	·001
Penzance	...	...	...	...	...	...	...	...	...	...	...	...
Plymouth	...	...	...	...	...	...	...	...	·001	...	...	·001
Portsmouth	...	·000	...	...	...	...	...	...	·001	...	·001	·002
Shields, North	·000	...	...	...	...	...	...	...	...	...	...	·000
Shields, South	...	...	...	...	...	...	...	...	...	...	...	...
Shoreham	...	...	...	...	...	...	...	...	...	...	...	...
Southampton	...	...	·038	...	...	...	...	...	...	...	·001	·039
Sunderland	...	...	...	3·755	...	...	...	...	...	·005	...	3·760
Weymouth	...	...	...	...	...	...	...	...	...	...	...	...
GREAT BRITAIN	14·294	1·910	·278	40·319	42·869	·022	·001	...	·015	·238	·054	100·000

Note.—For the Proportion per Cent. of the Number of Cattle, Sheep, and Swine, received from each Foreign Country, and the Proportion per Cen
Cattle, Sheep, and Swine from each Foreign Country

LIV.

WINE, landed at each Port of Great Britain from each Foreign Country, bears to the Total RITAIN, in the Year 1874.

SWINE.

British Port.	Belgium.	Denmark.	France.	Germany.	Nether-lands.	Norway.	Portugal.	Russia.	Spain.	Sweden.	Other Countries.	All Countries.
Barrow-in-Furness -	...	...	...	...	...	...	...	...	...	...	...	...
Bristol - - -	...	...	...	...	...	...	...	·011	·001	·001	·054	·067
Cardiff - - -	...	...	...	...	...	...	...	...	...	...	...	...
Dartmouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Dover - - -	...	...	·032	...	...	...	...	...	...	...	...	·032
Falmouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Folkestone - -	...	...	...	...	...	...	...	...	...	...	...	...
Glasgow - - -	...	...	...	...	...	...	...	...	...	...	·013	·013
Goole - - -	...	...	...	...	...	...	...	...	...	...	...	...
Grangemouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Granton - - -	...	...	...	...	...	...	...	...	...	...	...	...
Grimsby - - -	...	...	·163	2·602	1·289	...	...	·005	...	·002	·001	4·062
Hartlepool - -	...	...	...	1·093	...	...	...	·003	...	·274	·001	1·371
Harwich - - -	·296	...	...	...	5·776	...	...	...	...	...	...	6·072
Hull - - -	...	4·253	·048	4·517	3·601	...	·007	·001	...	...	·001	12·428
Kirkwall - -	...	...	...	...	...	...	...	...	...	...	...	...
Leith - - -	...	·034	...	...	...	...	...	...	...	...	...	·034
Littlehampton -	...	...	·034	...	...	...	...	...	...	...	...	·034
Liverpool - -	...	...	·002	...	...	...	·046	...	·002	...	·132	·182
London - - -	1·048	·007	11·925	1·470	32·321	...	...	...	...	·036	...	46·807
Middlesbrough -	...	...	...	·939	...	...	...	...	...	...	...	·939
Newcastle-upon-Tyne	...	2·063	...	1·109	·146	...	...	...	...	·017	·001	3·336
Newhaven - -	...	...	·085	...	...	...	...	...	...	...	...	·085
Penzance - -	...	...	...	...	...	...	...	...	...	...	...	...
Plymouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Portsmouth - -	...	...	9·799	...	...	...	...	...	...	...	...	9·799
Shields, North - -	...	...	...	...	...	...	...	...	...	...	...	...
Shields, South - -	...	...	...	...	...	...	...	...	...	...	·014	·014
Shoreham - -	...	...	·205	...	...	...	...	...	...	...	...	·205
Southampton - -	...	...	14·512	...	...	...	...	...	...	...	...	14·512
Sunderland - -	·002	...	·000	...	·002	...	...	·002	...	...	·002	·008
Weymouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Great Britain -	1·346	6·357	36·805	11·730	43·135	...	·053	·022	·003	·330	·219	100·000

ALL ANIMALS.

British Port.	Belgium.	Denmark.	France.	Germany.	Nether-lands.	Norway.	Portugal.	Russia.	Spain.	Sweden.	Other Countries.	All Countries.
arrow-in-Furness -	...	...	...	...	...	...	...	...	...	...	...	...
ristol - - -	...	...	...	...	...	...	...	·001	·000	·000	·007	·008
ardiff - - -	...	...	...	...	...	...	...	...	...	...	...	...
artmouth - -	...	...	...	...	...	...	...	...	...	...	...	...
over - - -	...	...	·003	...	...	...	...	...	...	...	...	·003
almouth - -	...	...	...	...	...	...	...	...	·385	...	·039	·424
olkestone - -	...	...	...	...	...	...	...	...	...	...	...	...
lasgow - - -	...	...	...	...	...	...	·002	...	...	...	·002	·004
oole - - -	·011	...	·001	...	·006	...	...	...	...	...	...	·018
rangemouth - -	...	...	...	...	...	...	...	...	...	...	...	...
ranton - - -	...	...	...	...	...	·013	...	...	...	·005	...	·018
rimsby - - -	...	...	·018	·309	·140	...	...	·001	...	·000	·000	·468
artlepool - -	...	...	...	2·453	...	...	...	·000	...	·169	·000	2·622
arwich - - -	5·195	...	...	...	9·186	...	...	...	...	...	...	14·381
ull - - -	·007	·657	·005	1·623	1·453	·055	·001	·000	...	...	·000	3·801
irkwall - - -	...	·005	...	...	...	...	...	...	...	...	...	·005
eith - - -	...	·969	...	·149	·043	...	...	...	...	...	·001	1·162
ittlehampton - -	...	...	·004	...	...	...	...	...	...	...	...	·004
iverpool - -	...	...	·000	·090	...	...	·343	...	·203	...	·043	·679
ondon - - -	5·189	·356	1·602	23·923	30·531	·053	·514	...	·208	·823	...	63·199
iddlesbrough -	...	...	...	·765	...	...	...	...	...	·002	...	·767
ewcastle-upon-Tyne	·002	2·573	...	3·321	·021	...	...	...	...	·015	·000	5·932
ewhaven - -	...	...	·009	...	...	...	...	...	...	...	...	·009
enzance - -	...	...	...	...	...	...	...	...	...	...	...	...
lymouth - -	...	...	...	...	...	...	...	...	·427	...	...	·427
ortsmouth - -	...	·001	1·061	...	...	...	...	...	·317	...	·001	1·380
hields, North - -	·000	...	...	...	...	...	...	...	...	...	...	·000
hields, South - -	...	...	...	...	...	...	...	...	...	...	·002	·002
horeham - -	...	...	·022	...	...	...	...	...	...	...	...	·022
outhampton - -	...	...	1·658	...	...	...	·311	...	·020	...	·000	1·989
underland - -	·000	...	·000	2·668	·000	...	...	·000	...	·008	·000	2·676
eymouth - -	...	...	...	...	...	...	...	...	...	...	...	...
Great Britain -	10·404	4·561	4·383	35·301	41·380	·121	1·171	·002	1·560	1·022	·095	100·000

led at each British Port *in each of the Years from 1870 to 1874 inclusive,* see Tables XLII. and XLIII. respectively. For the *Number* of h British Port, in the Year 1874, see Table XXXVII.

TABLE XLV.

RETURN of the Number of CATTLE, SHEEP, and SWINE Imported into GREAT BRITAIN from the CHANNEL ISLANDS, showing the Islands from which exported, and the British Ports at which landed, during each of the Years 1872, 1873, and 1874. (*See Note.*)

PORTS in GREAT BRITAIN at which Landed.	YEARS.	CATTLE.				SHEEP and LAMBS.	SWINE.	TOTAL ANIMALS.
		Oxen and Bulls.	Cows.	Calves.	Total.			
Dartmouth	1872	...	11	1	12	...	...	12
	1873	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...
Littlehampton	1872	...	18	...	18	...	...	18
	1873	...	16	...	16	...	...	16
	1874	...	...	...	...	...	...	...
London	1872	...	...	1	1	...	...	1
	1873	...	...	...	...	...	...	...
	1874	...	...	...	...	...	2	2
Newhaven	1872	1	82	3	86	...	...	86
	1873	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...
Plymouth	1872	2	121	7	130	...	...	130
	1873	10	167	8	185	...	85	270
	1874	2	109	11	122	...	1	12
Southampton	1872	43	2,101	16	2,160	...	24	2,184
	1873	70	1,970	47	2,087	...	12	2,099
	1874	51	1,786	11	1,848	...	...	1,848
Weymouth	1872	11	334	12	357	12	2	371
	1873	6	268	1	275	8	22	305
	1874	8	215	3	226	...	34	260
ISLANDS from which Exported.								
Alderney	1872	...	59	4	63	...	...	63
	1873	...	13	2	15	...	...	15
	1874	...	...	...	...	...	...	...
Guernsey	1872	16	548	8	572	12	24	608
	1873	23	629	49	701	8	20	729
	1874	17	560	12	589	...	37	626
Jersey	1872	41	2,060	28	2,129	...	2	2,131
	1873	63	1,779	5	1,847	...	99	1,946
	1874	44	1,550	13	1,607	...	...	1,607
TOTAL	1872	57	2,667	40	2,764	12	26	2,802
	1873	86	2,421	56	2,563	8	119	2,690
	1874*	61	2,110	25	2,196	...	37	2,233

Note.—These are not placed under the heading of Foreign Animals, as they are not treated as Foreign Animals by the Customs. They are, however, Foreign Animals under Section 6 of The Contagious Diseases (Animals) Act, 1869.

* For the Numbers landed at each Port of Great Britain, from each Island, in the Year 1874, see Table XLVI.

TABLE XLVI.

RETURN of the Number of CATTLE, SHEEP, and SWINE Imported into GREAT BRITAIN from the CHANNEL ISLANDS, showing the Islands from which exported, and the British Ports at which landed, during the Year 1874. (*See Note.*)

Islands from which Exported.	Ports in Great Britain at which Landed.	Cattle.				Sheep and Lambs.	Swine.	TOTAL ANIMALS.
		Oxen and Bulls.	Cows.	Calves.	Total.			
Guernsey - -	London - -	...	...	...	...	...	2	2
„ - -	Plymouth - -	1	54	5	60	...	1	61
„ - -	Southampton -	12	481	7	500	...	...	500
„ - -	Weymouth - -	4	25	...	29	...	34	63
Jersey - -	Plymouth - -	1	55	6	62	...	...	62
„ - -	Southampton -	39	1,305	4	1,348	...	...	1,348
„ - -	Weymouth - -	4	190	3	197	...	...	197
All Islands - -	London -	...	...	...	...	...	2	2
„ - -	Plymouth - -	2	109	11	122	...	1	123
„ - -	Southampton -	51	1,786	11	1,848	...	...	1,848
„ - -	Weymouth - -	8	215	3	226	...	34	260
TOTAL from ALDERNEY - -		...	...	...	...	...	...	...
„ „ GUERNSEY - -		17	560	12	589	...	37	626
„ „ JERSEY - -		44	1,550	13	1,607	...	...	1,607
TOTAL - - -		61	2,110	25	2,196	...	37	2,233

Note.—These are not placed under the heading of Foreign Animals, as they are not treated as Foreign Animals by the Customs. They are, however, Foreign Animals under Section 6 of The Contagious Diseases (Animals) Act, 1869.

No cases of Disease or Injury were found among the Cattle, Sheep, and Swine imported from the Channel Islands in the Year 1874.

For the Numbers landed at each British Port, and the Numbers from each Island, in *each of the Years 1872, 1873, and 1874*, see Table XLV.

TABLE

RETURN of the Number of FOREIGN ANIMALS brought by Sea to Ports in GREAT BRITAIN, which on inspection
CONTAGIOUS or INFECTIOUS DISEASE, specifying the Disease, and the Foreign Countries

PORTS IN GREAT BRITAIN TO WHICH BROUGHT.

PORTS.	Years.	Cattle Plague.				Pleuro-Pneumonia.	Foot-and-Mouth-Disease.				Sheep-Pox.	Sheep-Scab.	TOTAL.			
		Cattle.	Sheep.	Swine.	Total Animals	Cattle.	Cattle.	Sheep.	Swine.	Total Animals	Sheep.	Sheep.	Cattle.	Sheep.	Swine.	TOTAL ANIMALS
Falmouth	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	12	...	...	12	...	...	12	...	...	12
	1872	...	...	...	...	...	28	...	...	28	...	...	28	...	...	28
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Grimsby	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	4	...	4	...	4
	1872	...	...	...	...	...	...	44	65	109	...	...	...	44	65	109
	1873	...	...	...	...	...	...	...	1	1	...	...	...	...	1	1
	1874	...	...	...	...	...	...	...	1	1	...	...	...	...	1	1
Hartlepool	1870	...	...	...	...	...	19	11	...	30	...	...	19	11	...	30
	1871	...	...	...	...	...	2	3	53	58	...	1	2	4	53	59
	1872	1	...	...	1	...	167	32	...	199	...	...	168	32	...	200
	1873	...	...	...	...	...	5	2	...	7	...	...	5	2	...	7
	1874	...	...	...	...	...	17	2	73	92	...	...	17	2	73	92
Harwich	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	4	11	15	...	...	...	4	11	15
	1872	...	...	...	...	...	2	6	4	12	...	41	2	47	4	53
	1873	...	...	...	...	...	...	...	...	...	...	6	...	6	...	6
	1874	...	...	...	...	...	...	...	2	2	...	...	...	...	2	2
Hull	1870	...	...	...	...	...	...	...	18	18	...	...	...	...	18	18
	1871	...	...	...	...	1	...	...	...	...	...	37	1	37	...	38
	1872	...	...	...	...	...	1,087	636	36	1,759	...	90	1,087	726	36	1,849
	1873	...	...	...	...	...	78	29	...	107	...	21	78	50	...	128
	1874	...	...	...	...	1	123	37	68	228	...	2	124	39	68	231
Leith	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	4	54	...	58	...	...	4	54	...	58
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Littlehampton	1870	...	...	...	...	...	7	...	...	7	...	...	7	...	...	7
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Liverpool	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	2	...	2	...	2
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	40	...	...	40	...	...	40	...	...	40
London	1870	...	...	...	...	1	98	69	314	481	1	302	99	372	314	785
	1871	...	...	...	...	5	137	59	172	368	1	2,474	142	2,534	172	2,848
	1872	4	...	...	4	18	2,082	1,862	42	3,986	...	354	2,104	2,216	42	4,362
	1873	...	...	...	...	5	99	3	90	192	...	410	104	413	90	607
	1874	...	...	...	...	1	1,467	...	590	2,057	...	52	1,468	52	590	2,110
Middlesbrough	1870	...	...	...	...	...	...	...	2	2	...	1	...	1	2	3
	1871	...	...	...	...	...	7	...	16	23	...	4	7	4	16	27
	1872	...	...	...	...	...	63	58	...	121	...	...	63	58	...	121
	1873	...	...	...	...	...	...	18	...	18	...	...	...	18	...	18
	1874	...	...	...	...	...	4	5	...	9	...	...	4	5	...	9
Newcastle-upon-Tyne	1870	...	...	...	...	...	16	3	26	45	...	...	16	3	26	45
	1871	...	...	...	...	...	...	...	...	...	...	475	...	475	...	475
	1872	3	...	...	3	...	247	400	...	647	...	...	250	400	...	650
	1873	...	...	...	...	...	55	2	...	57	...	...	55	2	...	57
	1874	...	...	...	...	...	51	...	...	51	...	65	51	65	...	116
Plymouth	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	265	...	...	265	...	...	265	...	...	265
	1872	...	...	...	...	...	6	...	...	6	...	...	6	...	...	6
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Portsmouth	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	26	...	...	26	...	...	26	...	...	26
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shoreham	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	4	...	...	4	...	...	4	...	...	4
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Southampton	1870	...	...	...	...	...	162	49	522	733	...	...	162	49	522	733
	1871	...	...	...	...	...	158	...	...	158	...	...	158	...	...	158
	1872	...	...	...	...	...	12	...	72	84	...	...	12	...	72	84
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	23	...	...	23	...	...	23	...	...	23
Sunderland	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	1	2	44	...	46	...	...	3	44	...	47
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Note.—For Summary for the Year 1874, showing the Number of Diseased Animals from *each Foreign Country* to *each British Port*, see Table
for the Number landed at each Port of Great Britain in each of the above Years, see Table XXXV. For the *Proportion Per Cent.*

XLVII.

on landing, within each of the Years 1870, 1871, 1872, 1873, and 1874, have been found to be affected with any from which, and the British Ports to which, such Animals were brought.

FOREIGN COUNTRIES FROM WHICH BROUGHT.

Countries.	Years.	Cattle Plague.				Pleuro-Pneumonia.	Foot-and-Mouth Disease.				Sheep-Pox.	Sheep-Scab.	Total.			
		Cattle.	Sheep.	Swine.	Total Animals	Cattle.	Cattle.	Sheep.	Swine.	Total Animals	Sheep.	Sheep.	Cattle.	Sheep.	Swine.	Total Animals
Belgium -	1870	...	...	...	...	...	3	38	246	287	...	2	3	40	246	289
	1871	...	...	...	...	...	...	...	183	183	...	343	...	343	183	526
	1872	...	...	...	...	...	...	41	...	41	...	14	...	55	...	55
	1873	...	...	...	...	...	...	...	...	...	...	416	...	416	...	416
	1874	...	...	...	...	...	206	...	136	342	...	...	206	...	136	342
Denmark -	1870	...	...	...	...	...	8	...	...	8	...	...	8	...	...	8
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	2	...	2	...	...	...	2	...	2
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
France -	1870	...	...	...	...	...	184	46	522	752	...	...	184	46	522	752
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	26	261	72	359	...	1	26	262	72	360
	1873	...	...	...	...	...	...	...	90	90	...	...	...	...	90	90
	1874	...	...	...	...	...	304	...	43	347	...	52	304	52	43	399
Germany -	1870	...	...	...	...	...	67	14	66	147	1	301	67	316	66	449
	1871	...	...	...	...	1	88	62	69	219	1	2,642	89	2,705	69	2,863
	1872	4	...	...	4	18	3,452	2,814	107	6,373	...	414	3,474	3,228	107	6,809
	1873	...	...	...	...	5	204	54	1	259	...	20	209	74	1	284
	1874	...	...	...	...	1	220	40	141	401	...	67	221	107	141	469
Netherlands -	1870	...	...	...	...	1	40	31	48	119	...	...	41	31	48	120
	1871	...	...	...	...	5	...	4	...	4	...	10	5	14	...	19
	1872	...	...	...	...	1	181	18	40	239	...	9	182	27	40	249
	1873	...	...	...	...	...	3	...	...	3	...	1	3	1	...	4
	1874	...	...	...	...	1	...	4	414	418	...	...	1	4	414	419
Norway -	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	...	...	...	...	40	...	40	...	40
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Portugal -	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	201	...	...	201	...	...	201	...	...	201
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	30	...	...	30	...	...	30	...	...	30
	1874	...	...	...	...	...	995	...	...	995	...	...	995	...	...	995
Russia -	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	4	...	...	4	...	11	...	...	11	...	...	15	...	...	15
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spain -	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	292	...	...	292	...	...	292	...	...	292
	1872	...	...	...	...	...	60	...	...	60	...	...	60	...	...	60
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cape of Good Hope -	1870	...	...	...	...	...	...	3	...	3	...	...	...	3	...	3
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	...	...	...	...	7	...	7	...	7
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Chili -	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	2	...	2	...	2
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total -	1870	...	...	...	...	1	302	132	882	1,316	1	303	303	436	882	1,621
	1871	...	...	...	...	6	581	66	252	899	1	2,997	587	3,064	252	3,903
	1872	8	...	...	8	19	3,730	3,136	219	7,085	...	485	3,757	3,621	219	7,597
	1873	...	...	...	...	5	237	54	91	382	...	437	242	491	91	824
	1874	...	...	...	...	2	1,725	44	734	2,503	...	119	1,727	163	734	2,624

XLIX. For the Number of Cattle, Sheep, and Swine *Imported* from each Foreign Country in each of the above Years, see Table XXXVI.; and which the Number of Animals affected with each Disease bears to the Number Imported from each Country, in each Year, see Table LI.

TABLE

RETURN of the Number of FOREIGN ANIMALS brought by Sea to Ports in GREAT BRITAIN, which on INFECTIOUS DISEASE, specifying the Disease, and the Foreign Countries and Ports from which, and have been

ARRANGED ALPHABETICALLY ACCORDING TO BRITISH PORTS.

PORTS in GREAT BRITAIN to which brought.	FOREIGN COUNTRIES and PORTS from which brought.		DISEASE.	NUMBER OF ANIMALS AFFECTED.					DISPOSAL.	
				Cattle.	Sheep.	Goats.	Swine.	TOTAL.	Slaughtered at place of landing.	Otherwise disposed of.
Grimsby - -	Netherlands	Rotterdam -	Foot-and-Mouth -	...	...	...	1	1	1	...
Hartlepool -	Germany -	Hamburg -	Foot-and-Mouth -	17	2	...	73	92	92	...
Harwich - -	Netherlands	Rotterdam -	Foot-and-Mouth -	...	...	...	2	2	2	...
Hull - - -	Germany -	Bremerhafen -	Foot-and-Mouth -	...	1	...	...	1	1	...
„ - - -	„ -	Hamburg -	„ -	123	32	...	68	223	223	...
„ - - -	„ -	„ -	Sheep-Scab -	...	2	...	...	2	2	...
„ - - -	Netherlands	Harlingen -	Pleuro-Pneumonia	1	...	...	...	1	1	...
„ - - -	„ -	Rotterdam -	Foot-and-Mouth -	...	4	...	...	4	4	...
Liverpool - -	Portugal -	Oporto -	Foot-and-Mouth -	40	...	...	...	40	40	...
London - -	Belgium -	Antwerp -	Foot-and-Mouth -	206	...	...	...	206	206	...
„ - - -	„ -	Ostend -	„ -	...	...	...	136	136	136	...
„ - - -	France -	Boulogne -	„ -	258	...	...	...	258	258	...
„ - - -	„ -	Calais - -	Sheep-Scab -	...	52	...	...	52	52	...
„ - - -	„ -	Dunkirk -	Foot-and-Mouth -	...	...	...	43	43	43	...
„ - - -	„ -	Havre - -	„ -	43	...	...	...	43	43	...
„ - - -	Germany -	Bremen -	„ -	8	...	...	...	8	8	...
„ - - -	„ -	Hamburg -	Pleuro-Pneumonia	1	...	...	...	1	1	...
„ - - -	„ -	„ -	Foot-and-Mouth -	17	...	...	...	17	17	...
„ - - -	Netherlands	Rotterdam -	„ -	...	...	...	411	411	411	...
„ - - -	Portugal -	Oporto - -	„ -	935	...	...	...	935	935	...
Middlesbrough -	Germany -	Hamburg -	Foot-and-Mouth -	4	5	...	...	9	9	...
Newcastle-upon-Tyne	Germany -	Geestemünde -	Sheep-Scab -	...	65	...	...	65	65	...
„ „	„ -	Hamburg -	Foot-and-Mouth -	51	...	...	...	51	51	...
Southampton - -	France -	Honfleur -	Foot-and-Mouth -	3	...	...	...	3	3	...
„ - -	Portugal -	Oporto -	„ -	20	...	...	...	20	20	...

Note.—For Summary of this Return, showing the Number of Diseased Animals from *each Foreign Country* to *each British Port*, see Animals affected with *Diseases or Injuries of all Kinds*,

XLVIII.

inspection on landing, within the Year 1874, have been found to be affected with any CONTAGIOUS or the British Ports to which such Animals were brought, and the mode in which such Animals disposed of.

ARRANGED ALPHABETICALLY ACCORDING TO FOREIGN COUNTRIES AND PORTS.

FOREIGN COUNTRIES and PORTS from which brought.		PORTS in GREAT BRITAIN to which brought.	DISEASE.	NUMBER OF ANIMALS AFFECTED.					DISPOSAL.	
				Cattle.	Sheep.	Goats.	Swine.	TOTAL.	Slaughtered at place of landing.	Otherwise disposed of.
Belgium	Antwerp	London	Foot-and-Mouth	206	...	...	...	206	206	...
„	Ostend	„	„	...	...	...	136	136	136	...
France	Boulogne	London	Foot-and-Mouth	258	...	...	...	258	258	...
„	Calais	„	Sheep-Scab	...	52	...	...	52	52	...
„	Dunkirk	„	Foot-and-Mouth	...	...	...	43	43	43	...
„	Havre	„	„	43	...	...	...	43	43	...
„	Honfleur	Southampton	„	3	...	...	...	3	3	...
Germany	Bremen	London	Foot-and-Mouth	8	...	...	...	8	8	...
„	Bremerhafen	Hull	„	...	1	...	...	1	1	...
„	Geestemünde	Newcastle-upon-Tyne	Sheep-Scab	...	65	...	...	65	65	...
„	Hamburg	Hartlepool	Foot-and-Mouth	17	2	...	73	92	92	...
„	„	Hull	„	123	32	...	68	223	223	...
„	„	„	Sheep-Scab	...	2	...	...	2	2	...
„	„	London	Pleuro-Pneumonia	1	...	...	...	1	1	...
„	„	„	Foot-and-Mouth	17	...	...	...	17	17	...
„	„	Middlesbrough	„	4	5	...	...	9	9	...
„	„	Newcastle-upon-Tyne	„	51	...	...	...	51	51	...
Netherlands	Harlingen	Hull	Pleuro-Pneumonia	1	...	...	...	1	1	...
„	Rotterdam	Grimsby	Foot-and-Mouth	...	...	...	1	1	1	...
„	„	Harwich	„	...	...	...	2	2	2	...
„	„	Hull	„	...	4	...	...	4	4	...
„	„	London	„	...	...	...	411	411	411	...
Portugal	Oporto	Liverpool	Foot-and-Mouth	40	...	...	...	40	40	...
„	„	London	„	935	...	...	...	935	935	...
„	„	Southampton	„	20	...	...	...	20	20	...
TOTAL			Pleuro-Pneumonia	2	...	...	...	2	2	...
„			Foot-and-Mouth	1,725	44	...	734	2,503	2,503	...
„			Sheep-Scab	...	119	...	...	119	119	...
TOTAL				1,727	163	...	734	2,624	2,624	...

Table XLIX., and for Summary for the Years 1870, 1871, 1872, 1873, and 1874, see Table XLVII. For Returns of Imported Foreign see Tables LII. to LVI. inclusive.

TABLE XLIX.

SUMMARY of the NUMBER of FOREIGN ANIMALS brought by Sea to Ports in GREAT BRITAIN, which on inspection on landing, within the Year 1874, have been found to be affected with any CONTAGIOUS or INFECTIOUS DISEASE, specifying the Disease, and the Foreign Countries from which, and the British Ports to which, such Animals were brought.

FOREIGN COUNTRIES from which brought.	DISEASE.	BRITISH PORTS to which brought.																											TOTAL.			
		GRIMSBY.			HARTLEPOOL.			HARWICH.			HULL.			LIVERPOOL.			LONDON.			MIDDLESBROUGH.			NEWCASTLE-UPON-TYNE.			SOUTHAMPTON.						
		Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Total Animals.
BELGIUM -	Foot-and-Mouth -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	206	...	136	...	...	...	...	...	...	...	...	...	206	...	136	342
FRANCE -	Foot-and-Mouth -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	301	...	43	...	...	...	...	...	...	3	...	...	304	...	43	347
" -	Sheep-Scab -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	52	...	...	...	...	...	...	...	...	...	...	...	52	...	52
GERMANY -	Pleuro-Pneumonia -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
" -	Foot-and-Mouth -	...	...	...	17	2	73	...	...	...	123	33	68	...	...	...	25	...	...	4	5	...	51	...	...	...	...	...	220	40	141	401
" -	Sheep-Scab -	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	65	...	...	...	...	...	67	...	67
NETHERLANDS	Pleuro-Pneumonia -	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
" -	Foot-and-Mouth -	...	...	1	...	...	...	...	...	2	...	4	...	...	...	...	...	...	411	...	...	...	...	...	...	...	...	...	...	4	414	418
PORTUGAL -	Foot-and-Mouth -	...	...	...	...	...	...	...	...	...	...	...	...	40	...	...	935	...	...	...	...	...	...	...	...	20	...	...	995	...	...	995
TOTAL -	Pleuro-Pneumonia -	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	2	...	...	2
" -	Foot-and-Mouth -	...	...	1	17	2	73	...	...	2	123	37	68	40	...	...	1,467	...	590	4	5	...	51	...	...	23	...	...	1,725	44	734	2,503
" -	Sheep-Scab -	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	52	...	...	...	...	...	65	...	...	...	...	...	119	...	119
TOTAL - - - -		...	...	1	17	2	73	...	...	2	124	39	68	40	...	...	1,468	52	590	4	5	...	51	65	...	23	...	...	1,727	163	734	2,624

Note.—For Details of this Summary, see Table XLVIII., and for Summary of the Number of Imported Foreign Animals affected with *Diseases or Injuries of all Kinds*, see Table LIII. For the *Proportion per Cent.*, which the Number of Animals affected with each Disease bears to the Number Imported from each Country, see Table L. For the Number of Cattle, Sheep, and Swine *Imported* into each British Port, from each Foreign Country, see Table XXXVII.

TABLE L.

NUMBER of CATTLE, SHEEP, and SWINE IMPORTED into GREAT BRITAIN from EACH COUNTRY in the Year 1874; the Number which were AFFECTED with any CONTAGIOUS or INFECTIOUS DISEASE; and the PROPORTIONS PER CENT. which the DISEASED Animals bear to the TOTAL Importation of the same Class of Animal from each Country.

COUNTRIES.	TOTAL NUMBER IMPORTED.				TOTAL NUMBER DISEASED.*				PROPORTIONS PER CENT. OF DISEASED ANIMALS.									
									PLEURO-PNEUMONIA.	FOOT-AND-MOUTH DISEASE.				SHEEP-SCAB.	ALL DISEASES.			
	Cattle.	Sheep.	Swine.	TOTAL.	Cattle.	Sheep.	Swine.	TOTAL.	Cattle.	Cattle.	Sheep.	Swine.	ALL ANIMALS.	Sheep.	Cattle.	Sheep.	Swine.	ALL ANIMALS.
Belgium	1,086	108,193	1,552	110,831	206	...	136	342	...	18·9687	...	8·7629	·3086	...	18·9687	...	8·7629	·3086
Denmark	26,800	14,456	7,330	48,586	...	...	...	...	...	...	...	...	...	...	...	...	...	...
France	2,145	2,105	42,442	46,692	304	52	43	399	...	14·1725	...	·1013	·7432	2·4703	14·1725	2·4703	·1013	·8545
Germany	57,368	305,186	13,527	376,081	221	107	141	469	·0017	·3835	·0131	1·0424	·1066	·0220	·3852	·0351	1·0424	·1247
Netherlands	66,606	324,488	49,740	440,834	1	4	414	419	·0015	...	·0012	·8323	·0948	...	·0015	·0012	·8323	·0950
Norway	1,121	168	...	1,289	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Portugal	12,412	4	61	12,477	995	...	...	995	...	8·0164	...	...	7·9747	...	8·0164	...	...	7·9747
Russia	...	...	25	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spain	16,509	113	4	16,626	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sweden	8,704	1,799	381	10,884	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Countries	345	412	252	1,009	...	...	...	...	...	...	...	...	...	...	...	...	...	...
ALL COUNTRIES	193,096	756,924	115,314	1,065,334	1,727	163	734	2,624	·0010	·8933	·0058	·6365	·2349	·0157	·8943	·0215	·6365	·2463

Note.—For Summary of Per-Centages, for the Years 1870, 1871, 1872, 1873, and 1874, see Table LI.

* For the Numbers affected with *each Disease*, see Table XLIX.

TABLE LI.

TABLE showing the PROPORTIONS PER CENT. which the Numbers of Animals affected with CONTAGIOU or INFECTIOUS DISEASE bear to the TOTAL NUMBER of the same Class of Animal IMPORTED int GREAT BRITAIN, from each FOREIGN COUNTRY, in the Years 1870, 1871, 1872, 1873, and 1874.

COUNTRIES.	YEARS.	Cattle Plague.	Pleuro-Pneumonia.	Foot-and-Mouth Disease.				Sheep-Pox.	Sheep-Scab.	ALL CONTAGIOUS DISEASES.			
		Cattle.	Cattle.	Cattle.	Sheep.	Swine.	Total Animals.	Sheep.	Sheep.	Cattle.	Sheep.	Swine.	TOTAL ANIMAL
Belgium -	1870	...	...	·3027	·0284	1·7545	·1931	...	·0015	·3027	·0299	1·7545	·1944
	1871	...	...	...	...	8·7184	·1714	...	·3286	...	·3286	8·7184	·4925
	1872	...	...	...	·0675	...	·0675	...	·0231	...	·0906	...	·0906
	1873	...	...	...	...	...	...	...	·2756	...	·2756	...	·2727
	1874	...	...	18·9687	...	8·7629	·3086	...	...	18·9687	...	8·7629	·3086
Denmark -	1870	...	...	·0992	...	...	·0508	...	...	·0992	...	...	·0508
	1871	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	·0116	...	·0055	...	...	...	·0116	...	·0055
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
France -	1870	...	...	2·6818	1·4475	2·9201	2·6939	...	...	2·6818	1·4475	2·9201	2·6939
	1871	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	3·8067	1·1974	2·4374	1·4115	...	·0046	3·8067	1·2020	2·4374	1·4154
	1873	...	...	...	...	·2195	·1799	...	...	...	...	·2195	·1799
	1874	...	...	14·1725	...	·1013	·7432	...	2·4703	14·1725	2·4703	·1013	·8545
Germany -	1870	...	...	·1249	·0068	·3506	·0528	·0005	·1460	·1249	·1533	·3506	·1612
	1871	...	·0013	·1141	·0126	·1914	·0362	·0002	·5371	·1154	·5499	·1914	·4732
	1872	·0072	·0323	6·1977	·5954	8·3204	1·2033	...	·0876	6·2372	·6830	8·3204	1·2857
	1873	...	·0084	·3406	·0137	·0223	·0564	...	·0051	·3490	·0188	·0223	·0619
	1874	...	·0017	·3835	·0131	1·0424	·1066	...	·0220	·3852	·0351	1·0424	·1247
Netherlands -	1870	...	·0013	·0524	·0096	·1088	·0269	...	...	·0537	·0096	·1088	·0271
	1871	...	·0047	...	·0013	...	·0009	...	·0033	·0047	·0046	...	·0042
	1872	...	·0017	·3105	·0078	·4052	·0802	...	·0039	·3122	·0117	·4052	·0835
	1873	...	...	·0051	...	...	·0009	...	·0004	·0051	·0004	...	·0011
	1874	...	·0015	...	·0012	·8323	·0948	...	...	·0015	·0012	·8323	·0950
Norway -	1870	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	...	·7904	...	·7904	...	·6120
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
Portugal -	1870	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	·9823	...	...	·9802	...	...	·9823	...	...	·9802
	1872	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	·1775	...	...	·1753	...	...	·1775	...	...	·1753
	1874	...	...	8·0164	...	...	7·9747	...	...	8·0164	...	...	7·9747
Russia -	1870	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...
	1872	·5772	...	1·5873	...	...	1·5151	...	...	2·1645	...	...	2·0661
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
Spain -	1870	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	1·4612	...	...	1·4580	...	...	1·4612	...	...	1·4580
	1872	...	...	·3899	...	...	·3894	...	...	·3899	...	...	·3894
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
Sweden -	1870	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...
	1872	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
Other Countries -	1870	...	...	...	·8451	...	·2783	...	...	...	·8451	...	·2783
	1871	...	...	...	...	...	...	...	8·3333	...	8·3333	...	·2809
	1872	...	...	...	...	...	...	...	20·0000	...	20·0000	...	1·1475
	1873	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...
ALL COUNTRIES -	1870	...	·0005	·1497	·0196	·9069	·1354	·0001	·0451	·1502	·0648	·9069	·1668
	1871	...	·0024	·2348	·0072	·2943	·0719	·0001	·3268	·2372	·3341	·2943	·3122
	1872	·0047	·0110	2·1687	·3869	1·3638	·7095	...	·0598	2·1844	·4467	1·3638	·7608
	1873	...	·0025	·1191	·0064	·1139	·0339	...	·0514	·1216	·0578	·1139	·0730
	1874	...	·0010	·8933	·0058	·6365	·2349	...	·0157	·8943	·0215	·6365	·2463

Note.—For the *Number* of Animals *Imported* in each Year, from each Country, see Table XXXVI., and for the *Number* of Animals affected with *each Disease*, see Table XLVII.

TABLE LII.

NUMBER of FOREIGN CATTLE, SHEEP, and SWINE Landed DEAD or SLAUGHTERED, on account of DISEASE or INJURIES, at the 32 PORTS of GREAT BRITAIN at which FOREIGN ANIMALS might be landed, during each of the Years 1872, 1873, and 1874.

Cause of Slaughter or of Death.	Years.	Slaughtered at the Place of Landing.									Landed Dead.									Total Slaughtered and Landed Dead.								
		Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.		
		Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
Cattle Plague - -	1872	‡3	...	...	5	...	...	8	...	...	...	...	...	...	...	...	...	...	...	‡3	...	...	5	...	...	8	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pleuro-Pneumonia - -	1872	17	...	...	2	...	...	19	...	...	...	...	...	...	...	...	...	...	...	17	...	...	2	...	...	19	...	...
	1873	4	...	...	1	...	...	5	...	...	...	...	...	...	...	...	...	...	...	4	...	...	1	...	...	5	...	...
	1874	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	4	...	...	4	...	...
Foot-and-Mouth Disease	1872	3,719	3,136	219	11	...	...	3,730	3,136	219	1	...	...	4	...	...	5	...	...	3,720	3,136	219	15	...	...	3,735	3,136	219
	1873	237	54	91	...	...	...	237	54	91	...	...	...	...	...	...	...	...	...	237	54	91	...	...	...	237	54	91
	1874	1,725	44	734	...	...	...	1,725	44	734	1	...	...	2	...	...	3	...	...	1,726	44	734	2	...	...	1,728	44	734
Sheep-Scab - -	1872	...	485	...	...	...	...	...	485	...	...	1	...	...	...	...	...	1	...	...	486	...	...	...	...	...	486	...
	1873	...	437	...	...	...	...	...	437	...	...	1	...	...	...	...	...	1	...	...	438	...	...	...	...	...	438	...
	1874	...	119	...	...	...	...	...	119	...	...	...	...	...	...	...	...	...	...	...	119	...	...	...	...	...	119	...
Miscellaneous Diseases* -	1872	3	1	1	3	2	2	6	3	3	...	...	...	2	...	...	2	...	...	3	1	1	5	2	2	8	3	3
	1873	10	28	4	1	1	11	11	29	15	1	...	...	4	2	25	5	2	25	11	28	4	5	3	36	16	31	40
	1874	2	23	5	...	...	16	2	23	21	3	1	...	...	1	141	3	2	141	5	24	5	...	1	157	5	25	162
Injuries, Exhaustion, and Suffocation -	1872	378	2,237	125	46	44	11	424	2,281	136	99	245	19	79	235	25	178	480	44	477	2,482	144	125	279	36	602	2,761	180
	1873	490	2,114	619	12	38	17	502	2,152	636	89	218	53	50	452	132	139	670	185	579	2,332	672	62	490	149	641	2,822	821
	1874	565	1,796	1,077	7	15	29	572	1,811	1,106	105	209	162	74	375	139	179	584	301	670	2,005	1,239	81	390	168	751	2,395	1,407
Unknown§ - -	1872	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	1	1	...	...	...	...	1	1	...	1	1	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	1	...	...	...	1	...	1	1	...	1
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL - -	1872	4,120	5,859	345	67	46	13	4,187	5,905	358	100	246	19	86	236	25	186	482	44	4,220	6,105	364	153	282	38	4,373	6,387	402
	1873	741	2,633	714	14	39	28	755	2,672	742	90	219	53	55	454	158	145	673	211	831	2,852	767	69	493	186	900	3,345	953
	1874	2,292	1,982	1,816	9	15	45	2,301	1,997	1,861	109	210	162	78	376	280	187	586	442	2,401	2,192	1,978	87	391	325	2,488	2,583	2,303

Note.—For the Number of Animals found, on inspection on landing, to be affected with *Contagious or Infectious Diseases only*, showing the Number from *each Foreign Country*, and the Number landed at *each British Port*, in each of the Years 1870, 1871, 1872, 1873, and 1874, see Table XLVII. For the Number of Animals *Imported* in each Year, see Table XXXIII. For the *Proportion Per Cent.* which the Number of Animals affected with each Disease bears to the Number Imported from each Country, in each Year, see Table LI. For Summary for the *Year* 1874, see Table LIII. For Summary for the Port of *London* for the Years 1870, 1871, 1872, 1873, and 1874, see Table LIV.

* Diseases other than Cattle Plague, Pleuro-Pneumonia, Foot-and-Mouth Disease, Sheep-Pox, Sheep-Scab, Glanders, and Farcy, are described in this Table as "Miscellaneous Diseases."

† Diseased parts destroyed.

‡ These 3 Animals were in a very early stage of the Disease.

§ The carcases of these Animals were examined, but the cause of death could not be ascertained.

TABLE LIII.

SUMMARY TABLE showing the NUMBER of FOREIGN CATTLE, SHEEP, and SWINE Landed DEAD or SLAUGHTERED on account of DISEASE or INJURIES at the 32 PORTS of GREAT BRITAIN at which FOREIGN ANIMALS might be landed, during the Year 1874.

Country from which Exported.	Cause of Slaughter or of Death.	Slaughtered at the Place of Landing.									Landed Dead.									Total Slaughtered and Landed Dead.								
		Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.		
		Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
Belgium -	Pleuro-Pneumonia - -	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
" -	Foot-and-Mouth Disease - -	206	...	136	...	...	...	206	...	136	1	...	...	2	...	...	3	...	...	207	...	136	2	...	...	209	...	136
" -	Miscellaneous Diseases* - -	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	4	...	...	4
" -	Injuries, Exhaustion, and Suffocation	...	173	23	...	4	...	...	177	23	...	11	...	...	28	2	...	39	2	...	184	23	...	32	2	...	216	25
Denmark -	Miscellaneous Diseases * - -	...	...	1	...	...	...	...	...	1	...	...	...	...	...	8	...	...	8	...	...	1	...	...	8	...	...	9
" -	Injuries, Exhaustion, and Suffocation	36	3	25	2	...	...	38	3	25	5	...	9	8	6	14	13	6	23	41	3	34	10	6	14	51	9	48
France -	Foot-and-Mouth Disease - -	304	...	43	...	...	...	304	...	43	...	...	...	...	...	...	...	...	...	304	...	43	...	...	...	304	...	43
" -	Sheep-Scab - -	...	52	...	...	...	...	...	52	...	...	...	...	...	...	...	...	...	...	...	52	...	...	...	...	...	52	...
" -	Miscellaneous Diseases * - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...	1
" -	Injuries, Exhaustion, and Suffocation	...	9	244	...	...	4	...	9	248	...	...	94	...	...	28	...	...	122	...	9	338	...	...	32	...	9	370
Germany -	Pleuro-Pneumonia - -	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...
" -	Foot-and-Mouth Disease - -	220	40	141	...	...	...	220	40	141	...	...	...	...	...	...	...	...	...	220	40	141	...	...	...	220	40	141
" -	Sheep-Scab - -	...	67	...	...	...	...	...	67	...	...	...	...	...	...	...	...	...	...	...	67	...	...	...	...	...	67	...
" -	Miscellaneous Diseases* - -	1	23	4	...	...	1	1	23	5	...	...	...	...	1	3	...	1	3	1	23	4	...	1	4	1	24	8
" -	Injuries, Exhaustion, and Suffocation	83	659	73	1	3	7	84	662	80	6	72	5	18	35	19	24	107	24	89	731	78	19	38	26	108	769	104
Greece -	Miscellaneous Diseases* - -	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...
Netherlands -	Pleuro-Pneumonia - -	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...
" -	Foot-and-Mouth Disease - -	...	4	414	...	...	...	...	4	414	...	...	...	...	...	...	...	...	...	...	4	414	...	...	...	...	4	414
" -	Miscellaneous Diseases* -	...	...	...	...	...	13	...	...	13	...	...	...	...	...	127	...	...	127	...	...	...	...	...	140	...	...	140
" -	Injuries, Exhaustion, and Suffocation	162	952	712	2	8	18	164	960	730	32	126	54	31	305	71	63	431	125	194	1,078	766	33	313	89	227	1,391	855
Norway -	Injuries, Exhaustion, and Suffocation	6	...	...	...	...	...	6	...	...	8	...	...	...	...	...	8	...	...	14	...	...	...	...	...	14	...	...
Portugal -	Foot-and-Mouth Disease - -	995	...	...	...	...	...	995	...	...	...	...	...	...	...	...	...	...	...	995	...	...	...	...	...	995	...	...
" -	Injuries, Exhaustion, and Suffocation	83	...	...	...	...	...	83	...	...	33	...	...	5	...	...	38	...	...	116	...	...	5	...	...	121	...	...
Russia - -	Injuries, Exhaustion, and Suffocation	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	4	...	...	...	...	...	4	...	...	4
Spain - -	Injuries, Exhaustion, and Suffocation	86	...	...	...	...	...	86	...	...	18	...	...	8	...	...	26	...	...	104	...	...	8	...	...	112	...	...

Sweden -	Miscellaneous Diseases* - -	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...
" -	Injuries, Exhaustion, and Suffocation	109	...	...	2	...	...	111	...	...	1	...	...	4	1	1	5	1	1	110	...	...	6	1	1	116	1	1
Argentine Confederation }	Injuries, Exhaustion, and Suffocation	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...
Canada -	Miscellaneous Diseases* - -	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	3	...	...	3	...	...	...	...	...	3	...	...
ALL COUNTRIES	Pleuro-Pneumonia - -	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	4	...	...	4	...	...
" -	Foot-and-Mouth Disease* - -	1,725	44	734	...	...	...	1,725	44	734	1	...	...	2	...	...	3	...	...	1,726	44	734	2	...	...	1,728	44	734
" -	Sheep-Scab - - -	...	119	...	...	...	...	...	119	...	...	...	...	...	...	...	...	...	...	...	119	...	...	...	...	...	119	...
" -	Miscellaneous Diseases* - -	2	23	5	...	...	16	2	23	21	3	1	...	...	1	141	3	2	141	5	24	5	...	1	157	5	25	162
" -	Injuries, Exhaustion, and Suffocation	565	1,796	1,077	7	15	29	572	1,811	1,106	105	209	162	74	375	139	179	584	301	670	2,005	1,239	81	390	168	751	2,395	1,407
TOTAL -	BELGIUM - - -	206	173	159	...	4	2	206	177	161	1	11	...	4	28	4	5	39	4	207	184	159	4	32	6	211	216	165
"	DENMARK - - -	36	3	26	2	...	...	38	3	26	5	...	9	8	6	22	13	6	31	41	3	35	10	6	22	51	9	57
"	FRANCE - - -	304	61	287	...	...	4	304	61	291	...	...	94	...	...	29	...	...	123	304	61	381	...	...	33	304	61	414
"	GERMANY - - -	304	789	218	2	3	8	306	792	226	6	72	5	18	36	22	24	108	27	310	861	223	20	39	30	330	900	253
"	GREECE - - -	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...
"	NETHERLANDS - - -	162	956	1,126	3	8	31	165	964	1,157	32	126	54	31	305	198	63	431	252	194	1,082	1,180	34	313	229	228	1,395	1,409
"	NORWAY - - -	6	...	...	...	...	...	6	...	...	8	...	...	...	...	...	8	...	...	14	...	...	...	...	...	14	...	...
"	PORTUGAL - - -	1,078	...	...	...	...	...	1,078	...	...	33	...	...	5	...	...	38	...	...	1,111	...	...	5	...	...	1,116	...	...
"	RUSSIA - - -	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	4	...	...	...	...	...	4	...	...	4
"	SPAIN - - -	86	...	...	...	...	...	86	...	...	18	...	...	8	...	...	26	...	...	104	...	...	8	...	...	112	...	...
"	SWEDEN - - -	110	...	...	2	...	...	112	...	...	1	...	...	4	1	1	5	1	1	111	...	...	6	1	1	117	1	1
"	ARGENTINE CONFEDERATION -	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...
"	CANADA - - -	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	3	...	...	3	...	...	...	...	...	3	...	...
	TOTAL - - -	2,292	1,982	1,816	9	15	45	2,301	1,997	1,861	109	210	162	78	376	280	187	586	442	2,401	2,192	1,978	87	391	325	2,488	2,583	2,303

Note.— For the Port of London, see Table LV., and for the 31 other British Ports, Table LVI. For the Number of Animals found, on inspection on landing, to be affected with *Contagious or Infectious Diseases only*, showing the *Foreign Ports* from which, and the *British Ports* to which, such Animals were brought, see Table XLVIII.

* Diseases other than Cattle Plague, Pleuro-Pneumonia, Foot-and-Mouth Disease, Sheep-Pox, Sheep-Scab, Glanders, and Farcy, are described in this Table as "Miscellaneous Diseases."

† Diseased parts destroyed.

TABLE LIV.

NUMBER of FOREIGN CATTLE, SHEEP, and SWINE Landed DEAD or SLAUGHTERED at the PORT OF LONDON on account of DISEASE or INJURIES during each of the Years 1870, 1871, 1872, 1873, and 1874.

Cause of Slaughter or of Death.	Years.	Slaughtered at the Place of Landing.									Landed Dead.									Total Slaughtered and Landed Dead.								
		Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.		
		Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
Cattle Plague	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1872	‡3	...	...	1	...	...	4	...	...	...	...	...	...	...	...	...	...	...	‡3	...	...	1	...	...	4	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pleuro-Pneumonia	1870	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...
	1871	...	...	...	5	...	...	5	...	...	...	...	...	1	...	...	1	...	...	...	...	...	6	...	...	6	...	...
	1872	17	...	...	1	...	...	18	...	...	...	...	...	...	...	...	...	...	...	17	...	...	1	...	...	18	...	...
	1873	4	...	...	1	...	...	5	...	...	...	...	...	...	...	...	...	...	...	4	...	...	1	...	...	5	...	...
	1874	...	...	...	1	...	...	1	...	...	...	...	...	2	...	...	2	...	...	...	...	...	3	...	...	3	...	...
Foot-and-Mouth Disease	1870	98	69	314	...	...	...	98	69	314	...	...	...	...	...	...	...	...	...	98	69	314	...	...	...	98	69	314
	1871	137	59	172	...	...	...	137	59	172	...	...	...	...	...	...	...	...	...	137	59	172	...	...	...	137	59	172
	1872	2,081	1,862	42	1	...	...	2,082	1,862	42	...	...	...	...	...	...	...	...	...	2,081	1,862	42	1	...	...	2,082	1,862	42
	1873	99	3	90	...	...	...	99	3	90	...	...	...	...	...	...	...	...	...	99	3	90	...	...	...	99	3	90
	1874	1,467	...	590	...	...	...	1,467	...	590	1	...	...	2	...	...	3	...	...	1,468	...	590	2	...	...	1,470	...	590
Sheep-Pox	1870	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...
	1871	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1874	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sheep-Scab	1870	...	302	...	...	...	...	...	302	...	...	...	...	...	...	...	...	...	...	...	302	...	...	...	...	...	302	...
	1871	...	2,474	...	...	...	...	...	2,474	...	...	15	...	...	...	...	...	15	...	...	2,489	...	...	...	...	...	2,489	...
	1872	...	354	...	...	...	...	...	354	...	...	...	...	...	...	...	...	...	...	...	354	...	...	...	...	...	354	...
	1873	...	410	...	...	...	...	...	410	...	...	...	...	...	...	...	...	...	...	...	410	...	...	...	...	...	410	...
	1874	...	52	...	...	...	...	...	52	...	...	...	...	...	...	...	...	...	...	...	52	...	...	...	...	...	52	...
Miscellaneous Diseases*	1870	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1871	...	...	...	...	...	7	...	...	7	...	...	...	1	...	2	1	...	2	...	...	...	1	...	9	1	...	9
	1872	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1873	...	12	...	...	...	...	...	12	...	...	...	...	1	...	2	1	...	2	...	12	...	1	...	2	1	12	2
	1874	...	...	...	...	...	3	...	...	3	...	...	...	...	...	111	...	...	111	...	...	...	...	...	114	...	...	114
Injuries, Exhaustion, and Suffocation	1870	287	482	227	8	1	17	295	483	244	...	...	...	65	92	69	65	92	69	287	482	227	73	93	86	360	575	313
	1871	217	978	396	2	17	20	219	995	416	10	19	12	24	113	58	34	132	70	227	997	408	26	130	78	253	1,127	486
	1872	276	1,900	99	10	21	9	286	1,921	108	54	156	16	24	110	25	78	266	41	330	2,056	115	34	131	34	364	2,187	149
	1873	270	1,415	367	...	9	...	270	1,424	367	37	121	11	13	272	32	50	393	43	307	1,536	378	13	281	32	320	1,817	410
	1874	356	1,179	680	1	3	15	357	1,182	695	47	118	58	32	170	60	79	288	118	403	1,297	738	33	173	75	436	1,470	813
TOTAL	1870	386	853	541	8	2	17	394	855	558	...	...	...	65	92	69	65	92	69	386	853	541	73	94	86	459	947	627
	1871	354	3,511	568	7	18	27	361	3,529	595	10	34	12	26	113	60	36	147	72	364	3,545	580	33	131	87	397	3,676	667
	1872	2,377	4,116	141	13	21	9	2,390	4,137	150	54	156	16	24	110	25	78	266	41	2,431	4,272	157	37	131	34	2,468	4,403	191
	1873	373	1,840	457	1	9	...	374	1,849	457	37	121	11	14	272	34	51	393	45	410	1,961	468	15	281	34	425	2,242	502
	1874	1,823	1,231	1,270	2	3	18	1,825	1,234	1,288	48	118	58	36	170	171	84	288	229	1,871	1,349	1,328	38	173	189	1,909	1,522	1,517

Note.—For Detailed Return for the Year 1874, see Table LV.

* Diseases other than Cattle Plague, Pleuro-Pneumonia, Foot-and-Mouth Disease, Sheep-Pox, Sheep-Scab, Glanders, and Farcy, are described in this Table as "Miscellaneous Diseases."

† Diseased parts destroyed.

‡ These three animals were in a very early stage of the Disease.

TABLE LV.

NUMBER of FOREIGN CATTLE, SHEEP, and SWINE Landed DEAD or SLAUGHTERED at the PORT of LONDON on account of DISEASE or INJURIES during the Year 1874.

Country from which Exported.	Cause of Slaughter or of Death.	Slaughtered at the Place of Landing.									Landed Dead.									Total Slaughtered and Landed Dead.								
		Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.		
		Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
Belgium	Pleuro-Pneumonia	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...
"	Foot-and-Mouth Disease	206	...	136	...	...	...	206	...	136	1	...	...	2	...	...	3	...	...	207	...	136	2	...	...	209	...	136
"	Miscellaneous Diseases *	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	4	...	...	4
"	Injuries, Exhaustion, & Suffocation	...	128	19	...	...	...	...	128	19	...	...	...	...	13	1	...	13	1	...	128	19	...	13	1	...	141	20
Denmark	Injuries, Exhaustion, & Suffocation	1	2	...	...	...	...	1	2	...	1	...	...	...	...	...	1	...	...	2	2	...	...	...	...	2	2	...
France	Foot-and-Mouth Disease	301	...	43	...	...	...	301	...	43	...	...	...	...	...	...	...	...	...	301	...	43	...	...	...	301	...	43
"	Sheep-Scab	...	52	...	...	...	...	...	52	...	...	...	...	...	...	...	...	...	...	...	52	...	...	...	...	...	52	...
"	Miscellaneous Diseases *	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...	1
"	Injuries, Exhaustion, & Suffocation	...	9	94	...	...	...	...	9	94	...	...	8	...	...	3	...	...	11	...	9	102	...	...	3	...	9	105
Germany	Pleuro-Pneumonia	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...
"	Foot-and-Mouth Disease	25	...	...	...	...	...	25	...	...	...	...	...	...	...	...	...	...	...	25	...	...	...	...	...	25	...	...
"	Injuries, Exhaustion, & Suffocation	76	407	19	1	...	...	77	407	19	6	60	...	18	27	1	24	87	1	82	467	19	19	27	1	101	494	20
Netherlands	Foot-and-Mouth Disease	...	...	411	...	...	...	...	...	411	...	...	...	...	...	...	...	...	...	...	...	411	...	...	...	...	...	411
"	Miscellaneous Diseases *	...	...	...	...	...	1	...	...	1	...	...	...	...	...	108	...	...	108	...	...	...	...	...	109	...	...	109
"	Injuries, Exhaustion, & Suffocation	111	633	548	...	3	15	111	636	563	28	58	50	5	129	52	33	187	102	139	691	598	5	132	67	144	823	665
Norway	Injuries, Exhaustion, & Suffocation	6	...	...	...	...	...	6	...	...	8	...	...	...	...	...	8	...	...	14	...	...	...	...	...	14	...	...
Portugal	Foot-and-Mouth Disease	935	...	...	...	...	...	935	...	...	...	...	...	...	...	...	...	...	...	935	...	...	...	...	...	935	...	...
"	Injuries, Exhaustion, & Suffocation	25	...	...	...	...	...	25	...	...	3	...	...	3	...	...	6	...	...	28	...	...	3	...	...	31	...	...
Russia	Injuries, Exhaustion, & Suffocation	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	3	...	...	...	...	...	3	...	...	3
Spain	Injuries, Exhaustion, & Suffocation	32	...	...	...	...	...	32	...	...	1	...	...	2	...	...	3	...	...	33	...	...	2	...	...	35	...	...
Sweden	Injuries, Exhaustion, & Suffocation	105	...	...	...	...	...	105	...	...	...	...	...	4	1	...	4	1	...	105	...	...	4	1	...	109	1	...
TOTAL	Pleuro-Pneumonia	...	...	...	1	...	...	1	...	...	...	...	...	2	...	...	2	...	...	...	...	...	3	...	...	3	...	...
"	Foot-and-Mouth Disease	1,467	...	590	...	...	...	1,467	...	590	1	...	...	2	...	...	3	...	...	1,468	...	590	2	...	...	1,470	...	590
"	Sheep-Scab	...	52	...	...	...	...	...	52	...	...	...	...	...	...	...	...	...	...	...	52	...	...	...	...	...	52	...
"	Miscellaneous Diseases *	...	...	...	...	...	3	...	...	3	...	...	...	...	...	111	...	...	111	...	...	...	...	...	114	...	...	114
"	Injuries, Exhaustion, & Suffocation	356	1,179	680	1	3	15	357	1,182	695	47	118	58	32	170	60	79	288	118	403	1,297	738	33	173	75	436	1,470	813
	TOTAL	1,823	1,231	1,270	2	3	18	1,825	1,234	1,288	48	118	58	36	170	171	84	288	229	1,871	1,349	1,328	38	173	189	1,909	1,522	1,517

Note.—For Summary of the Number of cases for 1870, 1871, 1872, 1873, and 1874, see Table LIV.; and for the Number of Animals found, on inspection on landing, to be affected with *Contagious or Infectious Diseases only*, showing the *Foreign Ports* from which such Animals were brought, in the Year 1874, see Table XLVIII.

* Diseases other than Cattle Plague, Pleuro-Pneumonia, Foot-and-Mouth Disease, Sheep-Pox, Sheep-Scab, Glanders, and Farcy, are described in this Table as "Miscellaneous Diseases."

† Diseased parts destroyed.

TABLE LVI.

NUMBER of FOREIGN CATTLE, SHEEP, and SWINE Landed DEAD or SLAUGHTERED, on account of DISEASE or INJURIES, during the Year 1874, at the PORTS OF GREAT BRITAIN at which FOREIGN ANIMALS might be landed; *excepting the Port of London, for which see Table LV.* (*See Note.*)

Names of BRITISH PORTS.	COUNTRY from which Exported.	Cause of Slaughter or of Death.	Slaughtered at the Place of Landing.									Landed Dead.									Total Slaughtered and Landed Dead.								
			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.			Carcases delivered.†			Carcases destroyed.			Total.		
			Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.
Barrow-in-Furness	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bristol	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cardiff	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dartmouth	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dover ‡	France	Injuries, Exhaustion and Suffocation	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
Falmouth	Spain	Injuries, Exhaustion and Suffocation	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...	4	...	...	...	...	...	4	...	...
"	Argentine Cⁿ	" " "	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	2	...	...	2	...	...	...	...	...	2	...	...
Folkestone	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Glasgow	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Goole	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Grangemouth	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Granton ‡	Sweden	Injuries, Exhaustion and Suffocation	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...
Grimsby	Germany	Miscellaneous Diseases *	...	...	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1
"	"	Injuries, Exhaustion and Suffocation	...	...	21	...	...	4	...	...	25	...	...	...	...	...	...	...	...	...	...	...	21	...	...	4	...	...	25
"	Netherlands	Foot-and-Mouth Disease	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
"	"	Miscellaneous Diseases *	...	...	...	...	...	4	...	...	4	...	...	...	...	...	3	...	...	3	...	...	...	...	...	7	...	...	7
"	"	Injuries, Exhaustion and Suffocation	...	...	13	...	...	...	...	...	13	...	...	...	...	...	1	...	...	1	...	...	13	...	...	1	...	...	14
"	Russia	" " "	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...	1
Hartlepool	Germany	Foot-and-Mouth Disease	17	2	73	...	...	...	17	2	73	...	...	...	...	...	...	...	...	...	17	2	73	...	...	...	17	2	73
"	"	Miscellaneous Diseases *	1	5	2	...	...	...	1	5	2	...	...	...	...	...	...	...	...	...	1	5	2	...	...	...	1	5	2
"	"	Injuries, Exhaustion and Suffocation	2	43	8	...	...	...	2	43	8	...	...	...	...	1	2	...	1	2	2	43	8	...	1	2	2	44	10
"	Sweden	Miscellaneous Diseases *	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...
"	"	Injuries, Exhaustion and Suffocation	2	...	...	1	...	...	3	...	...	...	...	...	...	...	1	...	...	1	2	...	...	1	...	1	3	...	1
Harwich	Belgium	Injuries, Exhaustion and Suffocation	...	45	4	...	4	...	...	49	4	...	11	...	...	15	1	...	26	1	...	56	4	...	19	1	...	75	5
"	Netherlands	Foot-and-Mouth Disease	...	...	2	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	2
"	"	Injuries, Exhaustion and Suffocation	17	319	131	2	5	3	19	324	134	4	68	4	11	176	13	15	244	17	21	387	135	13	181	16	34	568	151
Hull	Denmark	Miscellaneous Diseases *	...	...	1	...	...	...	...	...	1	...	...	...	...	...	8	...	...	8	...	...	1	...	...	8	...	...	9
"	"	Injuries, Exhaustion and Suffocation	...	...	19	...	...	...	...	...	19	1	...	4	...	2	5	1	2	9	1	...	23	...	2	5	1	2	28
"	Germany	Foot-and-Mouth Disease	123	33	68	...	...	...	123	33	68	...	...	...	...	...	...	...	...	...	123	33	68	...	...	...	123	33	68
"	"	Sheep-Scab	...	2	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	2	...
"	"	Miscellaneous Diseases *	...	14	2	...	...	...	...	14	2	...	...	...	...	...	3	...	...	3	...	14	2	...	...	3	...	14	5
"	"	Injuries, Exhaustion and Suffocation	5	17	10	...	...	...	5	17	10	...	...	...	...	...	6	...	...	6	5	17	10	...	...	6	5	17	16
"	Netherlands	Pleuro-Pneumonia	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...
"	"	Foot-and-Mouth Disease	...	4	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	4	...
"	"	Miscellaneous Diseases *	...	...	...	...	...	8	...	...	8	...	...	...	...	...	16	...	...	16	...	...	...	...	...	24	...	...	24
"	"	Injuries, Exhaustion and Suffocation	33	...	20	...	...	...	33	...	20	...	...	...	14	...	5	14	...	5	33	...	20	14	...	5	47	...	25

Kirkwall	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Leith	Denmark	Injuries, Exhaustion and Suffocation	3	...	...	2	...	...	5	...	...	3	...	...	2	...	...	5	...	...	6	...	...	4	...	...	10	...	...
”	Netherlands	” ” ”	1	...	...	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	1	...	...	1	...	...	2	...	...
Littlehampton	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Liverpool	Germany	Injuries, Exhaustion and Suffocation	...	4	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	4	...
”	Greece	Miscellanous Diseases *	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...
”	Portugal	Foot-and-Mouth Disease	40	...	...	...	...	...	40	...	...	...	...	...	...	...	...	...	...	...	40	...	...	...	...	...	40	...	...
”	”	Injuries, Exhaustion and Suffocation	22	...	...	...	...	...	22	...	...	10	...	...	...	...	...	10	...	...	32	...	...	...	...	...	32	...	...
”	Spain	” ” ”	18	...	...	...	...	...	18	...	...	8	...	...	...	...	...	8	...	...	26	...	...	...	...	...	26	...	...
”	Canada	Miscellaneous Diseases *	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	3	...	...	3	...	...	...	...	...	3	...	...
London	- - -	*See Table* LV.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Middlesbrough	Germany	Foot-and-Mouth Disease	4	5	...	...	...	...	4	5	...	...	...	...	...	...	...	...	...	...	4	5	...	...	...	...	4	5	...
”	”	Miscellaneous Diseases *	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...	...	...	...	1	...	...	1	...
”	”	Injuries, Exhaustion and Suffocation	...	2	2	...	...	1	...	2	3	...	...	...	...	...	2	...	...	2	...	2	2	...	...	3	...	2	5
Newcastle-upon-Tyne§	Denmark	Injuries, Exhaustion and Suffocation	32	1	6	...	...	...	32	1	6	...	...	5	6	4	9	6	4	14	32	1	11	6	4	9	38	5	20
” ” ”	Germany	Foot-and-Mouth Disease	51	...	...	...	...	...	51	...	...	...	...	...	...	...	...	...	...	...	51	...	...	...	...	...	51	...	...
” ” ”	”	Sheep-Scab	...	65	...	...	...	...	...	65	...	...	...	...	...	...	...	...	...	...	...	65	...	...	...	...	...	65	...
” ” ”	”	Miscellaneous Diseases *	...	4	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	4	...
” ” ”	”	Injuries, Exhaustion and Suffocation	...	146	13	...	1	2	...	147	15	...	1	5	...	3	8	...	4	13	...	147	18	...	4	10	...	151	28
” ” ”	Sweden	” ” ”	2	...	...	1	...	...	3	...	...	...	...	...	...	...	...	...	...	...	2	...	...	1	...	...	3	...	...
Newhaven	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Penzance	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plymouth	Spain	Injuries, Exhaustion and Suffocation	10	...	...	...	...	...	10	...	...	3	...	...	2	...	...	5	...	...	13	...	...	2	...	...	15	...	...
Portsmouth	France	Injuries, Exhaustion and Suffocation	...	...	15	...	...	3	...	...	18	...	...	4	...	...	22	...	...	26	...	...	19	...	...	25	...	...	44
”	Spain	” ” ”	24	...	...	...	...	...	24	...	...	4	...	...	4	...	...	8	...	...	28	...	...	4	...	...	32	...	...
Shields, North	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shields, South	*See Note* ‡	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Shoreham ‡	France	Injuries, Exhaustion and Suffocation	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
Southampton	France	Foot-and-Mouth Disease	3	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	3	...	...
”	”	Injuries, Exhaustion and Suffocation	...	...	134	...	...	...	...	...	134	...	...	82	...	...	3	...	...	85	...	...	216	...	...	3	...	...	219
”	Portugal	Foot-and-Mouth Disease	20	...	...	...	...	...	20	...	...	...	...	...	...	...	...	...	...	...	20	...	...	...	...	...	20	...	...
”	”	Injuries, Exhaustion and Suffocation	36	...	...	...	...	...	36	...	...	20	...	...	2	...	...	22	...	...	56	...	...	2	...	...	58	...	...
Sunderland	Germany	Injuries, Exhaustion and Suffocation	...	40	...	...	2	...	...	42	...	...	11	...	...	4	...	...	15	...	...	51	...	...	6	...	...	57	...
Weymouth	*No Imports*	-	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
TOTAL FOR 31 PORTS. (*For the Port of London, see Table* LV.)		Pleuro-Pneumonia	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...	...
		Foot-and-Mouth Disease	258	44	144	...	...	...	258	44	144	...	...	...	...	...	...	...	...	...	258	44	144	...	...	...	258	44	144
		Sheep-Scab	...	67	...	...	...	...	...	67	...	...	...	...	...	...	...	...	...	...	...	67	...	...	...	...	...	67	...
		Miscellaneous Diseases*	2	23	5	...	...	13	2	23	18	3	1	...	...	1	30	3	2	30	5	24	5	...	1	43	5	25	48
		Injuries, Exhaustion and Suffocation	209	617	397	6	12	14	215	629	411	58	91	104	42	205	79	100	296	183	267	708	501	48	217	93	315	925	594
		TOTAL §	469	751	546	7	12	27	476	763	573	61	92	104	42	206	109	103	298	213	530	843	650	49	218	136	579	1,061	786

Note.—For the Number of Animals found, on inspection on landing, to be affected with *Contagious or Infectious Diseases only*, showing the *Foreign Ports* from which, and the *British Ports* to which, such Animals were brought, see Table XLVIII.

* Diseases other than Cattle Plague, Pleuro-Pneumonia, Foot-and-Mouth Disease, Sheep-Pox, Sheep-Scab, Glanders, and Farcy, are described in this Table as "Miscellaneous Diseases." † Diseased parts destroyed.

‡ Only 83 Animals were landed at Bristol, 37 at Dover, 44 at Glasgow, 183 at Goole, 195 at Granton, 54 at Kirkwall, 39 at Littlehampton, 102 at Newhaven, 1 at North Shields, 16 at South Shields, and 236 at Shoreham. (*See Table* XXXVII.)

§ In addition to the above, 1 Horse, which had been affected with Lung Disease, was landed dead at Newcastle-upon-Tyne. The animal was brought from Belgium. The carcase was delivered. (*See Note* †.)

TABLE LVII.

TABLE showing the QUANTITY of **DEAD MEAT** IMPORTED into GREAT BRITAIN from FOREIGN COUNTRIES and BRITISH POSSESSIONS ABROAD, during the Years 1870, 1871, 1872, 1873, and 1874; the QUANTITIES of each KIND of MEAT Imported in EACH YEAR; the AVERAGE of the Five Years; and the PROPORTION PER CENT. which such Quantities bear to the Total Quantity Imported in each Year, and to the Average.

(*From information contained in Parliamentary Papers Nos.* " *C. 437—1871,*" *for 1870;* " *C. 664—1872,*" *for 1871; and from Returns furnished by Her Majesty's Customs for 1872, 1873, and 1874.*)

YEARS.	QUANTITY OF EACH KIND OF MEAT.						PROPORTION PER CENT. OF EACH KIND OF MEAT.				
	BEEF (Salted or Fresh).†	PORK‡ (Salted or Fresh).†	BACON and HAMS.	MEAT NOT OTHERWISE DESCRIBED.		TOTAL.	BEEF (Salted or Fresh).†	PORK‡ (Salted or Fresh).†	BACON and HAMS.	MEAT NOT OTHERWISE DESCRIBED.	
				Salted or Fresh.	Preserved otherwise than by salting.					Salted or Fresh.	Preserved otherwise than by salting.
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	°/₀	°/₀	°/₀	°/₀	°/₀
1870 - - -	215,669	257,011	567,141	34,300	84,286	1,158,407	18·618	22·186	48·959	2·961	7·276
1871 - -	301,939	296,004	1,093,834	42,340	254,773	1,988,890	15·181	14·883	54·997	2·129	12·810
1872 - - -	228,898	218,230	2,001,809	54,942	350,640	2,854,519	8·019	7·645	70·128	1·925	12·283
1873 - -	260,474	289,605	2,987,217	79,772	260,653	3,877,721	6·717	7·469	77·035	2·057	6·722
1874* - -	261,632	328,530	2,542,070	119,328	265,145	3,516,705	7·440	9·342	72·285	3·393	7·540
AVERAGE - -	253,723	277,876	1,838,414	66,136	243,099	2,679,248	9·470	10·371	68·617	2·469	9·073

Note.—For the Total Quantities of Meat imported into the United Kingdom from *each Foreign Country*, in each of the above Years, see Table LVIII.

* For the Quantity of *each Kind of Meat* imported from *each Country* in the Year 1874, see Table LIX.

† Principally salted.

‡ Exclusive of Hams, which are included in the succeeding column.

TABLE LVIII.

TABLE showing the QUANTITY of **DEAD MEAT** Imported into the UNITED KINGDOM from FOREIGN COUNTRIES and BRITISH POSSESSIONS ABROAD during the Years 1870, 1871, 1872, 1873, and 1874; the QUANTITIES received from EACH COUNTRY, in EACH YEAR; the AVERAGE of the Five Years; and the PROPORTION PER CENT. which such Quantities bear to the Total Quantity imported: and showing also the QUANTITIES Imported into IRELAND, and into GREAT BRITAIN in each Year.

(*Compiled from the same Sources of Information as Table* LVII.)

YEARS.	Belgium.	Denmark.	France.	Germany.	Netherlands.	Russia.	Australia.	British North America.	United States of America.	Uruguay.	Other Countries.	TOTAL imported into the UNITED KINGDOM.	TOTAL imported into IRELAND.	TOTAL imported into GREAT BRITAIN.
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*
1870 - -	17,207	106,604	5,127	267,110	35,640	5,447	73,984	21,610	605,284	693	19,806	1,158,512	105	1,158,407
1871 - -	18,942	88,256	37,337	280,956	32,832	562	238,273	48,324	1,225,570	400	17,782	1,989,234	344	1,988,890
1872 - -	4,097	64,707	40,479	243,035	25,515	2,069	327,528	42,912	2,096,833	2,236	5,699	2,855,110	591	2,854,519
1873 - -	19,838	56,883	24,144	298,988	21,033	1,836	237,045	112,590	3,087,448	11,198	7,065	3,878,068	347	3,877,721
1874* - -	41,448	67,365	37,402	398,498	56,292	2,139	221,641	80,316	2,583,629	23,638	4,648	3,517,016	311	3,516,705
AVERAGE -	20,306	76,763	28,898	297,718	34,262	2,411	219,694	61,150	1,919,753	7,633	11,000	2,679,588	340	2,679,248
PROPORTION PER CENT. -	·758	2·865	1·078	11·111	1·279	·090	8·199	2·282	71·643	·285	·410	100·000	—	—

Note.—For the Quantities of *each Kind of Meat* Imported in each of the above Years, see Table LVII.

* For the Quantity of *each Kind of Meat* received from *each Country* in the Year 1874, see Table LIX.

TABLE LIX.

RETURN of the QUANTITY of **DEAD MEAT** Imported from FOREIGN COUNTRIES and BRITISH POSSESSIONS ABROAD during the Year 1874, showing the Quantity of each KIND of MEAT imported into GREAT BRITAIN; the Quantity from each COUNTRY imported into the UNITED KINGDOM; and the PROPORTIONS PER CENT. which such Quantities bear to the Total Quantity imported.

(*From a Return furnished by Her Majesty's Customs.*)

COUNTRIES from which Exported.	BEEF (Salted or Fresh.)*	PORK† (Salted or Fresh.)*	BACON and HAMS.	MEAT NOT OTHERWISE DESCRIBED.		TOTAL.	PROPORTION PER CENT. from each COUNTRY.
				Salted or Fresh.	Preserved otherwise than by salting.		
	Cwts.	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	*Cwts.*	%
BELGIUM	528	31,343	5,552	604	3,421	41,448	1·178
DENMARK	397	30,544	36,247	173	4	67,365	1·915
FRANCE	1,453	12,453	1,954	18,802	2,740	37,402	1·063
GERMANY	34,332	30,243	331,169	1,920	834	398,498	11·331
NETHERLANDS	101	477	362	55,236	116	56,292	1·601
RUSSIA	404	1	65	560	1,109	2,139	·061
AUSTRALIA	40	...	6	56	221,539	221,641	6·302
BRITISH NORTH AMERICA	5,969	2,581	69,989	1,728	49	80,316	2·284
UNITED STATES OF AMERICA	216,677	220,477	2,096,099	39,137	11,239	2,583,629	73·461
URUGUAY	1,172	...	...	904	21,562	23,638	·672
OTHER COUNTRIES	648	455	652	283	2,610	4,648	·132
TOTAL QUANTITY imported into the UNITED KINGDOM	261,721	328,574	2,542,095	119,403	265,223	3,517,016	100·000
,, ,, ,, ,, IRELAND	89	44	25	75	78	311	—
TOTAL QUANTITY imported into GREAT BRITAIN	261,632	328,530	2,542,070	119,328	265,145	3,516,705	—
PROPORTION PER CENT. of each KIND of MEAT	7·440	9·342	72·285	3·393	7·540	100·000	—

Note.—For Summaries for the years 1870 to 1874 inclusive, see Tables LVII. and LVIII.

* Principally salted.

† Exclusive of Hams, which are included in the succeeding column.

TABLE LX.

NUMBER of CATTLE, SHEEP, and SWINE brought for Sale into the CATTLE MARKET at **VIENNA**; and the Number of HORSES Slaughtered for Human Food at the Municipal Slaughter-Houses, during each of the Years 1872, 1873, and 1874.

(Compiled from Returns furnished—through Professor Müller, of the Vienna Imperial Veterinary College—by Dr. Zecha, Director of the Cattle Market at Vienna.)

YEARS.	CATTLE.					SHEEP.					SWINE.			HORSES Slaughtered for Human Food.
	Oxen, Bulls, and Cows.	Calves.			TOTAL.	Sheep.			Lambs.	TOTAL.	Carcases.	Living.	TOTAL.	
		Carcases.	Living.	Total.		Carcases.	Living.	Total.						
1872 -	164,430	99,595	80,840	180,435	344,865	11,817	161,889	173,706	47,285	220,991	18,962	160,109	179,071	*2,802
1873 -	204,735	118,530	77,577	196,107	400,842	11,028	183,437	194,465	56,642	251,107	18,988	182,965	201,953	†3,131
1874 -	185,653	116,427	71,421	187,848	373,501	12,965	168,931	181,896	47,960	229,856	20,031	176,902	196,933	‡4,427

* In addition to these Numbers, 21 Horses were prohibited to be Slaughtered for Human Food, 2 being affected with Glanders, 4 with Farcy, 2 with Glanders and Farcy, 1 with Typhus, and 12 with other Diseases.
† In addition to these Numbers, 23 Horses were prohibited to be Slaughtered for Human Food, 2 being affected with Glanders, 3 with Suspicious Discharge from the Nostrils, 1 with Typhus, and 17 with other Diseases.
‡ In addition to these Numbers, 16 Horses were prohibited to be Slaughtered for Human Food, 5 being affected with Glanders, 1 with Farcy, 1 with Suspicious Discharge from the Nostrils, and 9 with other Diseases.

TABLE LXI.

AVERAGE WHOLESALE and RETAIL PRICES of MEAT in **VIENNA**, during each of the Years 1870, 1871, 1872, 1873, and 1874. *(See Note.)*

(The data for the Years 1870, 1871, and 1872, compiled from a Return furnished through Professor Müller, of Berlin, which was prepared at the Market Commissariat, Vienna. The data for the Years 1873 and 1874, compiled from the same sources of information as the above Table.)

YEARS.	BEEF, *per lb.*		MUTTON, *per lb.*			PORK, *per lb.*				VEAL, *per lb.*			LAMBS, *per pair.*	HORSE FLESH, *per lb.*				
	Wholesale.	Retail.	Wholesale.		Retail.	Wholesale.		Retail.		Wholesale.		Retail.		Fore Quarter.	Hind Quarter.	Lungs and Roastings.	Fat (Raw).	Fat (Melted).
	Living.		Carcases.	Living.		Carcases.	Living.	Young Pigs.	Pork.	Carcases.	Living.							
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	£ *s.* *d.* £ *s.* *d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1870 -	$5\frac{3}{8}$ to $6\frac{9}{16}$	$5\frac{1}{4}$ to $7\frac{9}{16}$	... ...	... ...	$3\frac{5}{16}$ to $6\frac{13}{16}$	... ...	... ...	$6\frac{5}{8}$ to $9\frac{11}{16}$	$5\frac{7}{16}$ to $7\frac{3}{4}$	... ...	... ...	$4\frac{7}{8}$ to $8\frac{3}{16}$	... ...	...	...	...	...	...
1871 -	$5\frac{7}{16}$ „ $6\frac{3}{4}$	$5\frac{1}{16}$ „ $7\frac{15}{16}$	... ...	... ...	$3\frac{5}{16}$ „ 7	... ...	... ...	$6\frac{5}{8}$ „ $9\frac{11}{16}$	$5\frac{5}{8}$ „ $7\frac{15}{16}$	... ...	... ...	$5\frac{1}{4}$ „ $8\frac{3}{8}$	... ...	...	...	...	...	...
1872* -	$5\frac{9}{16}$ „ $6\frac{15}{16}$	$4\frac{7}{8}$ „ $8\frac{3}{16}$	... ...	... ...	$4\frac{1}{4}$ „ $7\frac{3}{16}$	... ...	... ..	$7\frac{3}{16}$ „ $10\frac{1}{2}$	$6\frac{7}{16}$ „ $9\frac{5}{16}$	... ...	... ...	$5\frac{5}{8}$ „ $9\frac{5}{16}$	... ...	...	..	...	...	...
1873 -	$5\frac{7}{16}$ „ $7\frac{1}{16}$	$4\frac{9}{16}$ „ $8\frac{9}{16}$	$4\frac{1}{8}$ to $5\frac{5}{8}$	$4\frac{9}{16}$ to $5\frac{11}{16}$	$3\frac{13}{16}$ „ $7\frac{3}{8}$	$6\frac{5}{8}$ to $7\frac{15}{16}$	$4\frac{7}{16}$ to $6\frac{1}{16}$	$7\frac{9}{16}$ „ $11\frac{1}{8}$	7 „ $10\frac{1}{8}$	$4\frac{13}{16}$ to $8\frac{9}{16}$	$4\frac{1}{16}$ to $7\frac{3}{4}$	$5\frac{5}{16}$ „ $10\frac{9}{16}$	0 12 8 to 1 7 6	$2\frac{5}{16}$	$2\frac{3}{4}$	$3\frac{1}{8}$	$5\frac{7}{16}$	7
1874 -	$3\frac{5}{16}$ „ $7\frac{1}{16}$	$3\frac{7}{8}$ „ $8\frac{9}{16}$	$2\frac{5}{16}$ „ $5\frac{5}{8}$	$2\frac{3}{4}$ „ $6\frac{3}{16}$	$2\frac{3}{4}$ „ $8\frac{3}{16}$	$4\frac{11}{16}$ „ $8\frac{9}{16}$	$3\frac{1}{2}$ „ $7\frac{3}{16}$	7 „ $12\frac{7}{16}$	$5\frac{1}{16}$ „ $11\frac{11}{16}$	$2\frac{15}{16}$ „ $7\frac{3}{4}$	$2\frac{1}{2}$ „ 7	$3\frac{7}{8}$ „ $10\frac{1}{2}$	0 8 0 „ 1 8 0	$2\frac{1}{8}$	$2\frac{3}{4}$	$3\frac{1}{8}$	6	$7\frac{3}{8}$

Note.—Converted into British Money on the assumption that 1 *Florin* of 100 *Kreuzer* = 2*s.* Sterling; and into British Weight on the assumption that 1 *Centner* of 100 *Pfund* = $123\frac{1}{2}$ *lbs.* Avoirdupois.
* The Prices for the Year 1872 are calculated upon the 11 months ending November.

TABLE LXII.

AVERAGE RETAIL PRICES of MEAT per lb. during the Months of September 1872, September 1873, and September 1874, in the **CHIEF TOWNS** of the **PRUSSIAN DEPARTMENTS,** from Official Reports of the Prices supplied to the Government, by the Local Authorities of each Chief Town.

(*From Returns furnished by Professor Müller, of Berlin.*)

NO.	CHIEF TOWN OF DEPARTMENT.	BEEF.			MUTTON.			PORK.			VEAL.		BACON.
		1872.	1873.	1874.	1872.	1873.	1874.	1872.	1873.	1874.	1873.	1874.	1874.
		d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*
1	Berlin*	6 11/16	7 3/8	7 3/16	6 3/8	7 1/16	6 7/8	7 3/16	7 5/8	7 7/16	7 1/16	6 5/8	9 11/16
2	Königsberg	6 1/16	6 13/16	7 1/4	5 1/4	6 1/4	6 1/16	6 11/16	7 7/16	7 13/16	...	...	9 5/16
3	Gumbinnen	4 7/8	4 13/16	4 7/8	3 5/8	4 3/8	4 3/8	6	6 1/2	6 1/2	3 1/4	3 1/4	8 7/16
4	Danzig	6 1/4	7 7/8	7 1/16	5 7/16	6 1/2	6	6 1/2	7 5/8	7 1/16	7 5/8	...	9 13/16
5	Marienwerder	5 3/16	6 1/2	5 11/16	4 7/8	5 7/16	5 7/16	6 1/2	6 1/2	6 1/2	5 7/16	3 1/4	8 11/16
6	Stettin	6	6 7/16	6 7/8	6	6	6 5/8	7 1/16	7 1/16	7 1/16	5 7/16	6 1/16	9 7/8
7	Cöslin	6	7 1/16	6 1/2	4 7/8	6 1/2	5 7/16	6 1/2	7 5/8	7 5/8	5 7/16	4 7/8	10 7/8
8	Stralsund	5 11/16	6 1/4	6 3/8	5 7/16	6 3/16	6 1/2	6 13/16	7 1/4	6 5/8	5 7/16	7 3/16	9 13/16
9	Frankfort-on-the-Oder	7 1/16	7 7/8	7 3/4	5 11/16	7 1/16	7 3/8	7 3/8	8 11/16	8 7/16	7 5/8	7 3/8	10 5/16
10	Potsdam	6 5/8	7 1/2	6 13/16	6	7 3/8	7 1/16	7 1/16	7 7/8	8 3/16	7 3/8	7 1/16	9 13/16
11	Magdeburg	8 11/16	7	6 13/16	7 1/16	6 13/16	6 13/16	7 5/8	7 3/8	7 3/8	6 1/2	4 7/8	10 5/16
12	Merseburg	7 1/16	7 3/8	7 5/8	6	6 1/2	6 1/2	6 1/2	7 1/16	6 1/2	6 1/2	6	10 7/8
13	Erfurt	6 1/2	7 1/16	6 1/2	6	6 1/2	5 7/16	7 5/8	8 3/16	8 3/16	4 7/8	3 13/16	10 7/8
14	Posen	6 1/4	7 1/16	6 13/16	5 7/16	6 7/16	6	7 1/16	7 1/16	7 1/16	7 1/16	7 1/16	12
15	Bromberg	4 7/8	6 7/16	5 3/16	4 3/8	6 1/2	5 7/16	6	6 1/2	5 7/16	6 1/4	4 3/8	10 7/8
16	Breslau	7 1/16	6 1/4	6 1/4	6	6 1/2	6 1/2	7 1/16	7 5/8	7 5/8	6 1/2	6 1/2	10 7/8
17	Liegnitz	5 3/16	6 1/4	6	5 7/16	6	6 1/2	7 5/8	7 5/8	7 5/8	4 7/8	4 7/8	10 7/8
18	Oppeln	5 7/16	5 7/16	5 7/16	5 3/16	...	...	6 1/2	...	...	...	...	10 7/8
19	Münster	6 1/4	‡6 1/2	6	5 11/16	‡6 3/16	5 13/16	5 13/16	‡6 1/4	6	‡6 3/16	5 7/16	7 5/8
20	Minden	5 11/16	8	7 3/8	5 11/16	6 1/2	5 7/16	7 1/16	7 1/16	7 1/16	6	4 7/8	9 1/4
21	Hamm (Dep. Arnsberg)†	7 1/16	7 5/8	6 1/4	6	7 5/8	4 7/8	6 1/2	7 5/8	6 1/2	6 1/2	6 1/2	8 11/16
22	Cologne	7 1/16	7 5/8	7 1/16	...	8 3/16	7 5/8	...	9 1/4	8 11/16	8 3/16	6	9 13/16
23	Düsseldorf	7 13/16	8 7/16	7 7/8	7 13/16	8 3/16	7 5/8	8 11/16	8 11/16	8 11/16	10 5/16	7 1/16	9 13/16
24	Aix-la-Chapelle	8 7/16	8 11/16	8 3/16	8 11/16	8 11/16	8 11/16	9 13/16	10 7/8	9 13/16	7 5/8	7 5/8	9 13/16
25	Coblenz	7 1/16	7 7/16	7 3/8	7 5/8	8 11/16	8 3/16	7 3/8	7 5/8	7 5/8	8 3/16	6 1/2	8 11/16
26	Schleswig	6 1/2	7	7 7/8	5 11/16	6 1/2	6 1/2	6 1/2	6 1/2	7 5/8	8 3/16	8 11/16	8 11/16
27	Treves	7 3/8	7 1/16	6 7/8	7 1/16	7 5/8	6 1/2	7 5/8	7 5/8	7 5/8	7 1/4	6 5/8	10 7/8
28	Hildesheim	6 1/2	7 3/8	7 1/16	6 1/2	7 3/8	6 13/16	7 1/16	7 5/8	7 5/8	7 3/8	6 13/16	10 7/8
29	Lüneburg	7 3/8	7 5/8	8 3/16	5 11/16	6 1/2	6 1/2	6 1/4	6 13/16	7 1/16	6 1/2	7 3/16	10 7/16
30	Osnabrück	6 1/2	6 13/16	6	5 1/16	6 1/2	5 11/16	6 1/2	6 1/2	6 1/2	6 1/2	6 1/4	9 1/4
31	Hanover	6 1/4	6 1/2	6	6 1/4	5 13/16	5 7/8	6 1/4	6 3/8	6	5 11/16	5 7/16	9 1/4
32	Stade	6 1/4	6 13/16	6 13/16	5 7/16	6	6	6 1/2	7 3/8	7 1/16	6 1/2	6	10 5/16
33	Aurich	6 1/4	7 5/8	6	4 3/8	9 1/4	4 3/8	7 5/8	8 11/16	8 11/16	6	6	9 1/4
34	Cassel	7 5/8	8 3/16	8 3/16	6 1/2	7 1/16	6 5/8	8 1/16	8 3/16	8 1/2	6 7/16	5 9/16	9 1/4
35	Wiesbaden	7 3/16	7 13/16	7 1/8	6 13/16	7 7/16	7 7/16	7 3/16	7 7/16	7 7/16	7 7/16	6 13/16	8 11/16

Note.—Converted into British Money on the assumption that 1 *Groschen* of 12 *Pfennings* (Old German Currency) = 1 1/5 *Pence* Sterling; and into British Weight on the assumption that 1 *Pfund* = 1·1025 *lbs.* Avoirdupois.

* For the Average Wholesale Prices of Meat in Berlin, *during the whole Year*, in 1870, 1871, 1872, 1873, and 1874, see Table LXIV.; and for the Average Retail Prices during the same Years, see Table LXV.

† Arnsberg, the seat of government, is only a small town.

‡ The Prices quoted for Münster in 1873 are for the month of October.

TABLE LXIII.

NUMBER of CATTLE, SHEEP, and SWINE offered for sale at the Metropolitan Cattle Market, **BERLIN**, during each of the Years ending 31st March 1872, 31st March 1873, and 31st December 1874, and the Number of HORSES slaughtered in the Great Slaughter-House during each of the two latter Years.

(*From information furnished by Professor Müller, of Berlin, for the Years 1871–3; and by Dr. Pauli, Chief Veterinary Inspector, Berlin, for the Year 1874.*)

Years.	Cattle.			Sheep.	Swine.	Horses.
	Oxen, Bulls, and Cows.	Calves.	Total.			
April 1871 to March 1872 -	95,800	92,810	188,610	464,003	215,281	*...
April 1872 to March 1873†	110,231	97,138	207,369	595,577	227,027	3,141
January to December 1874‡	107,535	105,474	213,009	509,945	322,129	3,641

111,701 *Cwts.* of Meat (inclusive of Ham, Sausages, Salt Meat, &c.), were Imported into Berlin in the Year 1872.

* The Number of Horses slaughtered in 1871–72 has not been furnished.

† Of these Numbers, 190 Oxen, Bulls, and Cows, 366 Calves, 635 Sheep, and 848 Swine being declared suspicious cases of disease, were slaughtered under veterinary inspection, and a great number were condemned, as unfit for human food. 82 Horses were also condemned as unfit for human food. In the year 1872–3 there were reported in Berlin 126 Horses affected with Glanders, which were all slaughtered, and 70 Dogs affected with Madness (Rabies).

‡ 100 Horses (not included in the number given above), were condemned in the Year 1874 as unfit for Human Food. In the same Year 190 Horses affected with Glanders, were slaughtered in Berlin. Canine Madness was observed less than in the previous Year.

TABLE LXIV.

AVERAGE WHOLESALE PRICES of MEAT at the Slaughtering House of the Great Cattle Market, **BERLIN**, in the Years 1870, 1871, 1872, 1873 and 1874. (*See Note.*)

(*Compiled from Returns furnished by Professor Müller, of Berlin, for the Years 1870–3; and by Dr. Pauli, Chief Veterinary Inspector, Berlin, for the Year 1874.*)

Year.	Beef. (per 100 lbs.)			Pork. (per 100 lbs.)			Veal.* (per pound.)		Mutton* (per pound).
	First Quality.	Second Quality.	Third Quality.	First Quality.	Second Quality.	Third Quality.	First Quality.	Second Quality.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.	d.	d.
1870 - -	2 9 0	2 3 6	1 12 8	2 6 3	1 18 1	1 7 3	$4\frac{3}{8}$	$3\frac{1}{4}$	$4\frac{7}{8}$
1871 - -	2 14 5	2 9 0	2 3 6	2 9 0	2 3 6	1 12 8	$6\frac{1}{2}$	$4\frac{3}{8}$	$5\frac{7}{16}$
1872 - -	3 5 4	2 14 5	2 9 0	2 17 2	2 9 0	2 3 6	$8\frac{3}{16}$	$5\frac{7}{16}$	$6\frac{1}{2}$
1873† - -	2 13 8	2 4 0	1 13 11	2 11 10	2 4 2	1 17 10	...	...	$4\frac{15}{16}$ to $5\frac{3}{4}$
1874 - -	2 14 9	2 6 3	1 17 5	2 15 7	2 10 8	2 6 11	...	...	$5\frac{3}{16}$ „ $5\frac{11}{16}$

Note.—Converted into British Money on the assumption that 1 *Thaler* of 30 *Groschen* (Old German Currency) = 3*s*. Sterling; and into British Weight on the assumption that 1 *Kilogramme* of 2 *Pfund* = 2·205 *lbs*. Avoirdupois.

* Veal and Mutton are sold also in retail. These are prices given by persons taking large quantities.

† The Prices for the Year 1873 are calculated upon the Prices for the Market Day in the middle of each of the 11 Months ending November.

TABLE LXV.

AVERAGE RETAIL PRICES of MEAT per lb. in the Weekly **BERLIN** Markets, during the Years 1870, 1871, 1872, 1873, and 1874. (*See Note.*)

(*Compiled from Returns furnished by Professor Müller, of Berlin, for the Years 1870–3; and by Dr. Pauli, Chief Veterinary Inspector, Berlin, for the Year 1874.*)

YEAR.	BEEF.	PORK.	MUTTON.	VEAL.	HORSE-FLESH.
	d.	*d.*	*d.*	*d.*	*d.*
1870 - - -	$8\frac{3}{16}$	$7\frac{5}{8}$	$6\frac{1}{2}$	6	...
1871 - - -	$8\frac{11}{16}$	$8\frac{3}{16}$	$6\frac{1}{2}$	$6\frac{1}{2}$	...
1872 - - -	$9\frac{13}{16}$	$8\frac{3}{16}$	$7\frac{5}{8}$	$8\frac{3}{16}$	...
1873* - -	†$6\frac{3}{8}$ to $8\frac{9}{16}$	$6\frac{5}{8}$ to $8\frac{5}{8}$	$6\frac{1}{8}$ to 8	$6\frac{9}{16}$ to $8\frac{1}{2}$	...
1874 - -	$6\frac{1}{2}$ „ $9\frac{13}{16}$	$7\frac{1}{16}$ „ $8\frac{11}{16}$	6 „ $7\frac{5}{8}$	6 „ $8\frac{11}{16}$	‡$2\frac{3}{16}$ to $3\frac{1}{4}$

Note.—Converted into British Money on the assumption that 1 *Thaler* of 30 *Groschen* (Old German Currency) = 3*s.* Sterling; and into British Weight on the assumption that 1 *Kilogramme* of 2 *Pfund* = 2·205 *lbs.* Avoirdupois.

There are between 3,000 and 4,000 Horses slaughtered yearly at Berlin. Horse-flesh is much eaten by poor people and in the lower restaurants. The bad quality serves for dogs' and cats' meat. There is also much Horse-flesh in the sausages.

There are Horse Butchers in all the greater towns. Altona, near Hamburg (70,000–80,000 inhabitants), slaughters yearly about 1,000 to 1,200 Horses. Horse-flesh is an article for exportation (in form of sausages), principally for victualling ships.

* The prices quoted for 1873 are the average prices *at the Butchers' Shops*, and are calculated upon the 11 months ending November.

† The Average Price of the Fillet of Beef in the Year 1873, was $9\frac{13}{16}$*d.*, and of Salted Beef, $8\frac{11}{16}$*d.* per *lb.*

‡ The prices of Horse-flesh quoted for 1874, are for Meat fit for Human Food. The prices of the bad quality, for dogs' and cats' meat, were from $\frac{13}{16}$*d.* to $1\frac{5}{8}$*d.*

TABLE LXVI.

NUMBER of ANIMALS Offered for Sale for breeding stock and for slaughter at the Bi-Weekly Cattle Market, **FRANKFORT-ON-THE-MAINE**; Number of ANIMALS Slaughtered for Food; and the Average RETAIL PRICES of MEAT per lb. in the Years 1873 and 1874.

(*Compiled from information furnished by Herr Carl Schmidt, Royal Prussian Veterinary Surgeon.*)

PARTICULARS.	YEARS.	CATTLE.			SHEEP.			SWINE.			HORSES.
		Oxen, Bulls, & Cows.	Calves.	Total.	Sheep.	Lambs.	Total.	Swine.	Small Porkers.	Total.	
Number Offered for Sale -	1873	29,292	25,910	55,202	14,456	265	14,721	43,693	13,090	56,783	...
	1874	36,454	32,185	68,639	17,864	316	18,180	36,352	11,935	48,287	...
Number Slaughtered* -	1873	12,365	30,550	42,915	24,618	324	24,942	...	...	28,528	604
	1874	12,654	34,076	46,730	23,049	343	23,392	32,527	786	33,313	462

		BEEF.	VEAL.	MUTTON.	PORK.	HORSE-FLESH.	
						For Boiling.	For Roasting.
		d.	*d.*	*d.*	*d.*	*d.*	*d.*
Average Prices of Meat† -	1873	$8\frac{3}{16}$	$7\frac{9}{16}$	$6\frac{5}{8}$	$7\frac{1}{4}$	$1\frac{13}{16}$	$2\frac{3}{4}$
	1874	$7\frac{13}{16}$	7	$6\frac{15}{16}$	8	$1\frac{13}{16}$	$2\frac{3}{4}$

* The Number of Animals slaughtered being, in some cases, greater than the Number offered for sale, may be explained by the fact, that the Slaughterers also collect Animals from other sources than the Cattle Market at Frankfort-on-the-Maine.

† Converted into British Money on the assumption that 3 *Kreuzer* (Old German Currency) = 1 *Penny* Sterling; and into British Weight on the assumption that 1 *Kilogramme* = 2·205 *lbs.* Avoirdupois. No distinction in Prices, with respect to the quality of the Meat, is recognised at Frankfort-on-the-Maine.

TABLE LXVII.

NUMBER of ANIMALS Offered for Sale at the Cattle Market, **DRESDEN,** and the Number Slaughtered for Food, in the Year 1874; and the Average RETAIL PRICES of MEAT per lb. in the Years 1873 and 1874.

(*From information furnished by Professor Müller, of Berlin, which was given by the Inspector of the Dresden Slaughter-Houses, for the Year 1873; and by Dr. Leisering, Professor in the Dresden Veterinary College, for the Year 1874.*)

PARTICULARS.	YEARS.	CATTLE.			SHEEP.			GOATS.	SWINE.	HORSES.
		Horned Cattle.	Calves.	TOTAL.	Sheep.	Lambs.	TOTAL.			
Number Offered for Sale -	1874	20,114	20,026	40,140	58,013	14	58,027	20	51,319	...
Number Slaughtered* - -	1874	12,352	11,761	24,113	11,201	...	11,201	...	14,338	†500
		BEEF.	VEAL.		MUTTON.			GOAT-FLESH.	PORK.	HORSE-FLESH.
		d.	d.		d.				d.	d.
Average Prices of Meat‡	1873	$7\frac{1}{16}$ to $7\frac{5}{8}$	$5\frac{3}{16}$ to $6\frac{1}{4}$		$6\frac{1}{2}$ to $7\frac{1}{16}$			...	$7\frac{1}{16}$ to $7\frac{5}{8}$	...
	1874	$7\frac{1}{16}$	$4\frac{3}{8}$ to $6\frac{1}{2}$		$6\frac{1}{2}$			...	$7\frac{5}{8}$	$2\frac{3}{16}$

* These are the Numbers of Animals slaughtered at the Dresden Slaughter-House. Many butchers are allowed to slaughter Animals in their own houses.

† This Number is approximate. There are two Horse-Butchers in Dresden, who slaughtered about this number of Horses in 1874. In 1873 there was only one Horse-Butcher, who slaughtered in the Year about 300 Horses.

‡ Converted into British Money on the assumption that 1 *Groschen* (Old German Currency) = $1\frac{1}{5}$ *Pence* Sterling, and that 1 *Mark* of 100 *Pfennigs* (New German Currency) = 1*s.* Sterling; and into British Weight on the assumption that 1 *Pfund* = 1·1025 *lbs.* Avoirdupois.

TABLE LXVIII.

NUMBER of ANIMALS Offered for Sale at the Cattle Market, **MUNICH**; Number of ANIMALS Slaughtered for Food; and the Average RETAIL PRICES of MEAT per lb. in the Years 1873 and 1874.

(*Compiled from information furnished by Herr Probstmayer, Royal Bavarian Veterinary Director.*)

PARTICULARS.	YEARS.	CATTLE.				SHEEP and GOATS.			SWINE.		HORSES
		Oxen, Bulls, and Cows.	Heifers.	Calves.	TOTAL.	Sheep and Goats.	Lambs and Kids.	TOTAL.	All kinds.	TOTAL.	
Number Offered for Sale -	1873	34,217	5,346	144,329	183,892	13,800	6,334	20,134	46,978	46,978	...
	1874	47,658	5,223	189,587	242,468	17,579	45,102	62,681	68,327	68,327	4,861

PARTICULARS.	YEARS.	Oxen.	Cows and Steers.	Heifers.	Calves.	TOTAL.	Sheep and Goats.	Lambs and Kids.	TOTAL.	Fattened Swine.	Common Swine.	Young Boars.	Sucking Pigs.	TOTAL.	HORSES
Number Slaughtered*	1873	15,171	20,368	2,039	135,933	173,511	14,264	47,305	61,569	16,342	34,848	575	20,504	72,269	†364
	1874	14,722	22,880	4,069	174,010	215,681	18,241	44,560	62,801	16,021	36,002	740	17,777	70,540	348

PARTICULARS.	YEARS.	BEEF.			VEAL.			MUTTON.	PORK.		HORSE-FLESH.
		Ox Beef.	Cow Beef.								
		Fattened.	Fattened.	2nd Quality	1st Quality	2nd Quality	3rd Quality		Fresh.	Smoked.	
		d.	d.	d.	d.	d.	d.	d.	d.	d.	
Average Prices of Meat‡ -	1873	$6\frac{9}{16}$	$6\frac{3}{16}$	$5\frac{3}{4}$	$6\frac{1}{2}$	$5\frac{3}{8}$	$3\frac{13}{16}$	$4\frac{7}{16}$	$7\frac{5}{16}$	$10\frac{1}{4}$	...
	1874	$6\frac{1}{16}$	$5\frac{7}{16}$	$4\frac{13}{16}$	$5\frac{3}{4}$	$4\frac{13}{16}$	$3\frac{15}{16}$	$3\frac{15}{16}$ to $4\frac{13}{16}$	$6\frac{1}{16}$ to $7\frac{1}{4}$	$10\frac{1}{4}$	$1\frac{13}{16}$

* The Number of Animals slaughtered being, in some cases, greater than the Number offered for sale, may probably be explained in the same way as in the case of Frankfort-on-the-Maine. See Note * to Table LXVI.

† One Donkey was also Slaughtered.

‡ Converted into British Money on the assumption that 3 *Kreuzer* (Old German Currency) = 1 *Penny* Sterling; and into British Weight on the assumption that 500 *Grammes* = 1·1025 *lbs.* Avoirdupois. The different parts of the Meat are sold together, but the inferior parts must not exceed a fifth of the weight. The Fillet alone is sold, without any admixture of inferior parts, at about one third higher prices.

TABLE LXIX.

AVERAGE WHOLESALE and RETAIL PRICES of MEAT per lb. in **HAMBURG (ALTONA)**, in the Years 1870, 1871, 1872, 1873, and 1874. *(See Note.)*

(From Returns furnished by Professor Müller, of Berlin, for the Years 1870, 1871, and 1872; and by Professor Köhne, State Veterinary Surgeon, Hamburg, for the Years 1873 and 1874.)

YEARS.	BEEF.				MUTTON.				PORK.			VEAL.			
	WHOLESALE.*		RETAIL.		WHOLESALE.*		RETAIL.		WHOLESALE.*	RETAIL.		WHOLESALE.*		RETAIL.	
	First Quality.	Inferior Quality.	First Quality.	Inferior Quality.	First Quality.	Inferior Quality.	First Quality.	Inferior Quality.	All Qualities.	First Quality.	Inferior Quality.	First Quality.	Inferior Quality.	First Quality.	Inferior Quality.
	d. *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*	*d.* *d.*
1870	$5\frac{7}{8}$ to $6\frac{1}{4}$	$5\frac{3}{8}$ to $5\frac{7}{8}$	$5\frac{11}{16}$ to $6\frac{1}{8}$	$4\frac{7}{8}$ to $5\frac{5}{16}$	$5\frac{11}{16}$ to $6\frac{1}{2}$	$4\frac{7}{8}$ to $5\frac{11}{16}$	$5\frac{11}{16}$ to $6\frac{1}{8}$	$4\frac{7}{8}$ to $5\frac{11}{16}$	$5\frac{1}{4}$ to $5\frac{3}{4}$	$5\frac{11}{16}$ to $6\frac{1}{2}$	$4\frac{7}{8}$ to $5\frac{11}{16}$	$6\frac{1}{2}$ to $7\frac{3}{8}$	$5\frac{11}{16}$ to $6\frac{1}{2}$	$7\frac{3}{8}$ to $8\frac{3}{16}$	$6\frac{1}{2}$ to $7\frac{3}{8}$
1871	$6\frac{11}{16}$ „ $7\frac{1}{16}$	$5\frac{1}{2}$ „ $6\frac{1}{4}$	$5\frac{11}{16}$ „ $6\frac{1}{8}$	$4\frac{7}{8}$ „ $5\frac{5}{16}$	$5\frac{11}{16}$ „ $6\frac{1}{2}$	$4\frac{7}{8}$ „ $5\frac{11}{16}$	$5\frac{11}{16}$ „ $6\frac{1}{2}$	$4\frac{7}{8}$ „ $5\frac{11}{16}$	†$4\frac{11}{16}$ „ $4\frac{13}{16}$ †$5\frac{1}{4}$ „ $5\frac{3}{8}$	$5\frac{11}{16}$ „ $6\frac{1}{8}$	$4\frac{7}{8}$ „ $5\frac{5}{16}$	$7\frac{3}{8}$ „ $8\frac{3}{16}$	$6\frac{1}{8}$ „ $6\frac{1}{2}$	$7\frac{3}{8}$ „ $8\frac{3}{16}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$
1872	‡$6\frac{11}{16}$ „ $7\frac{1}{16}$ ‡$7\frac{7}{16}$ „ $7\frac{13}{16}$	$6\frac{1}{4}$ „ $6\frac{11}{16}$ $6\frac{11}{16}$ „ $6\frac{11}{16}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$	$5\frac{11}{16}$ „ $6\frac{15}{16}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$	$4\frac{7}{8}$ „ $5\frac{11}{16}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$	$4\frac{7}{8}$ „ $5\frac{11}{16}$	$5\frac{3}{4}$ „ $6\frac{1}{2}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$	$6\frac{1}{2}$ „ $6\frac{15}{16}$	‡$6\frac{15}{16}$ „ $7\frac{3}{4}$ ‡$8\frac{3}{16}$ „ $10\frac{5}{8}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$ $8\frac{3}{16}$ „ 9	$7\frac{3}{8}$ „ $8\frac{3}{16}$ 9 „ $11\frac{7}{16}$	$6\frac{1}{2}$ „ $7\frac{3}{8}$ $8\frac{3}{16}$ „ 9
1873	$7\frac{5}{8}$ „ $8\frac{1}{2}$	$6\frac{3}{4}$ „ $7\frac{1}{2}$	$7\frac{5}{8}$ „ $9\frac{13}{16}$	$6\frac{1}{2}$ „ $7\frac{5}{8}$	$8\frac{3}{16}$ „ $9\frac{1}{8}$	$7\frac{5}{8}$ „ $8\frac{11}{16}$	$8\frac{11}{16}$ „ $11\frac{7}{16}$	$7\frac{5}{16}$ „ $10\frac{5}{16}$	$5\frac{7}{8}$ „ $6\frac{1}{2}$	$7\frac{5}{8}$ „ $8\frac{11}{16}$	$6\frac{1}{2}$ „ $7\frac{5}{8}$	$7\frac{5}{8}$ „ $10\frac{1}{4}$	$7\frac{5}{8}$ „ $8\frac{11}{16}$	$8\frac{3}{16}$ „ $13\frac{1}{16}$	$6\frac{1}{2}$ „ $10\frac{7}{8}$
1874	$7\frac{5}{8}$	$6\frac{11}{16}$	$7\frac{5}{8}$ „ $9\frac{13}{16}$	$6\frac{1}{2}$ „ $7\frac{5}{8}$	$7\frac{15}{16}$	$7\frac{1}{16}$	$7\frac{5}{8}$ „ $9\frac{13}{16}$	$6\frac{1}{2}$ „ $8\frac{3}{16}$	$5\frac{15}{16}$	$7\frac{3}{8}$ „ $8\frac{15}{16}$	$6\frac{1}{2}$ „ $8\frac{3}{16}$	$8\frac{11}{16}$	$7\frac{7}{8}$	$7\frac{3}{8}$ „ $11\frac{7}{16}$	$6\frac{1}{2}$ „ $9\frac{13}{16}$

Note.—Converted into British Money on the assumption that 1 *Mark* of 100 *Pfennigs* (New German Currency) = 1*s.* Sterling; and into British Weight on the assumption that 1 *Kilogramme* of 2 *Pfund* = 2·205 *lbs.* Avoirdupois.

* At the Wholesale Prices quoted above, the offal is probably thrown in; this would account for such prices being, in some cases, higher than the Retail Prices.

† The *upper* prices are for the *first*, the *lower* for the *second* half of the year.

‡ The *upper* prices are those *before*, the *lower* those *after* the breaking out of Cattle Plague.

LONDON: Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE, Printers to the Queen's most Excellent Majesty. For Her Majesty's Stationery Office.

Vol 27. pp. 787–886.

[C. 1302] Weights and Measures. Ninth Annual Report of the Warden of the Standards for 1874–75.

For this Report see the Volume lettered XXVII Octavo Portions

REPORTS

FROM

COMMISSIONERS, INSPECTORS,

AND OTHERS:

TWENTY-SEVEN VOLUMES.

—*(14.)*—

ENDOWED SCHOOLS; SCIENTIFIC INSTRUCTION AND ADVANCEMENT OF SCIENCE.

Session

5 February —— 13 *August* 1875.

VOL. XXVIII.

1875.

REPORTS

FROM

COMMISSIONERS, INSPECTORS,

AND OTHERS:

1875.

TWENTY-SEVEN VOLUMES:—CONTENTS OF THE

FOURTEENTH VOLUME.

N.B.—*THE* Figures *at the* beginning of the line, *correspond with the* N° *at the foot of each* Report; *and the* Figures *at the* end of the line, *refer to the* MS. Paging *of the Volumes arranged for The House of Commons.*

---

* ENDOWED SCHOOLS:

✓ [c. 1142.] Report of the Endowed Schools Commissioners - - p. 1. *Octavo.*

SCIENTIFIC INSTRUCTION AND ADVANCEMENT OF SCIENCE:

✓ [c. 1279.] Sixth Report of the Royal Commission on Scientific Instruction and the Advancement of Science; with Appendices - 59

✓ [c. 1297.] Seventh Report; with Appendices - - - - - 337

✓ [c. 1298.] Eighth Report; with Appendices - - - - - 417

✓ [c. 1363.] Minutes of Evidence, Vol. III., and Appendices; Analysis of Evidence, Index to the Eight Reports (with their Appendices), and General Index to the Evidence, and to the Appendices to the Evidence given in Vols. I.—III. - - - - 473

---

* For this Report see the end of Vol. XIX.

Vol XXVIII.—Sess. 1875.

Vol 28. pp. 1–58.

[C. 1142] Endowed Schools. Report of the Commissioners.

For this 8vo Report see the End of Vol XIX.

SIXTH REPORT

OF THE

ROYAL COMMISSION

ON

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1875.

[C.—1279.] *Price 5s. 3d.*

CONTENTS.

	Page
COMMISSIONS - - - - -	iii
REPORT - - - - - -	1
APPENDICES - - - - -	11

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Right Trusty and Right Entirely Beloved Cousin William Duke of Devonshire, Knight of Our Most Noble Order of the Garter,—Our Right Trusty and Entirely Beloved Cousin Henry Charles Keith Marquess of Lansdowne,—Our Trusty and Wellbeloved Sir John Lubbock, Baronet,—Our Trusty and Wellbeloved Sir James Phillips Kay-Shuttleworth, Baronet,—Our Trusty and Wellbeloved Bernhard Samuelson, Esquire,—Our Trusty and Wellbeloved William Sharpey, Esquire, Doctor of Medicine,—Our Trusty and Wellbeloved Thomas Henry Huxley, Esquire, Professor of Natural History in the Royal School of Mines,—Our Trusty and Wellbeloved William Allen Miller, Esquire, Doctor of Medicine, Professor of Chemistry in Kings College, London,—and Our Trusty and Wellbeloved George Gabriel Stokes, Esquire, Master of Arts, Lucasian Professor of Mathematics in the University of Cambridge, Greeting:

Whereas We have deemed it expedient for divers good causes and considerations that a Commission should forthwith issue to make Inquiry with regard to Scientific Instruction and the Advancement of Science and to Inquire what aid thereto is derived from Grants voted by Parliament or from Endowments belonging to the several Universities in Great Britain and Ireland and the Colleges thereof and whether such aid could be rendered in a manner more effectual for the purpose.

Now Know Ye that We reposing great Trust and Confidence in your Ability and Discretion have nominated constituted and appointed and do by these Presents nominate constitute and appoint you the said William, Duke of Devonshire—Henry Charles Keith, Marquess of Lansdowne—Sir John Lubbock—Sir James Phillips Kay-Shuttleworth—Bernhard Samuelson—William Sharpey—Thomas Henry Huxley—William Allen Miller—and George Gabriel Stokes—to be Our Commissioners for the purposes of the said Inquiry.

And for the better enabling you to carry Our Royal Intentions into effect We do by these Presents authorize and empower you or any three or more of you to call before you or any three or more of you such persons as you may judge necessary by whom you may be the better informed of the matters herein submitted for your consideration and also to call for and examine all such Books Documents Papers or Records as you shall judge likely to afford you the fullest information on the subject of this Our Commission and to Inquire of and concerning the Premises by all other lawful ways and means whatsoever.

And Our further Will and Pleasure is that you or any three or more of you do Report to Us under your Hands and Seals (with as little delay as may be consistent with a due discharge of the Duties hereby imposed upon you) your opinion on the several matters herein submitted for your consideration, with power to certify unto Us from time to time your several proceedings in respect of any of the matters aforesaid, if it may seem expedient for you so to do.

And We do further Will and Command and by these Presents ordain that this Our Commission shall continue in full force and virtue and that you Our said Commissioners or any three or more of you shall and may from time to time proceed in the

execution thereof and of every matter and thing therein contained although the same be not continued from time to time by adjournment.

And for your assistance in the execution of these Presents We do hereby authorize and empower you to appoint a Secretary to this Our Commission to attend you whose services and assistance we require you to use from time to time as occasion may require.

Given at Our Court at Saint James's, the Eighteenth day of May 1870, in the Thirty-third year of Our Reign.

By Her Majesty's Command,

H. A. BRUCE.

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Trusty and Well-beloved Henry John Stephen Smith, Esquire, Master of Arts, Savilian Professor of Geometry in Our University of Oxford, Greeting:

Whereas We did by Warrant, under Our Royal Sign Manual, bearing date the Eighteenth Day of May, One Thousand Eight Hundred and Seventy, appoint Our Right Trusty and Right Entirely Beloved Cousin, William, Duke of Devonshire, Knight of Our Most Noble Order of the Garter, Our Right Trusty and Entirely Beloved Cousin, Henry Charles Keith, Marquess of Lansdowne, together with the several Gentlemen therein named, to be Our Commissioners to make Inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from Grants voted by Parliament, or from Endowments belonging to the several Universities in Great Britain and Ireland, and the Colleges thereof, and whether such aid could be rendered in a manner more effectual for the purpose: And whereas since the issue of the said Warrant William Allen Miller, Doctor of Medicine, one of the Commissioners thereby appointed, hath deceased:

Now Know Ye, that We, reposing great Trust and Confidence in Your Zeal, Discretion, and Integrity, have authorized and appointed, and do by these Presents authorize and appoint you the said Henry John Stephen Smith to be a Commissioner for the purpose aforesaid, in addition to, and together with, the Commissioners now acting under the above-mentioned Royal Warrant.

Given at Our Court at Saint James's the First Day of December 1870, in the Thirty-Fourth Year of Our Reign.

By Her Majesty's Command,
H. A. BRUCE.

Professor Henry John Stephen Smith, M.A.,
To be a Commissioner for inquiring into
Scientific Instruction and the Advancement of Science.

SIXTH REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

MAY IT PLEASE YOUR MAJESTY,

WE, the Commissioners appointed by Your Majesty to make Inquiry with regard to Scientific Instruction and the Advancement of Science, humbly beg leave to present to Your Majesty, in continuation of our former Reports, the following Report on the Teaching of Science in Public and Endowed Schools.

I. Preliminary Remarks.

1. In dealing with that branch of the Inquiry entrusted to us which has reference to the Scientific Instruction given in the various Secondary Schools throughout the country, we have been induced by the circumstances of the case to deviate from the mode of obtaining information which we had hitherto adopted. The number of Secondary Schools is so considerable that any attempt to obtain the facts by examination of Witnesses would have necessitated the attendance of a very large number, while, by adopting a different method of procuring information we were enabled not only to economise time, but to obtain a comparative survey of the various Systems and Appliances of Instruction employed in the different Schools.

2. With this view our Secretary, Mr. Lockyer, was appointed Assistant Commissioner with reference to this branch of the Inquiry, and by means of personal visits, and by the circulation of various forms of questions agreed upon between him and the Commissioners, much information has been obtained, which will be found in an Appendix to the present Report.

Appendices II.—IV.

3. The following are the Public and Endowed Schools to which attention was specially directed:—

Eton College, Rugby School, St. Peter's College Westminster, Harrow School, Winchester College, Charterhouse School, Marlborough College, Dulwich College, City of London School, University College School, King's College School, Taunton College School, Wellington College, Rossall School, Clifton College, Cheltenham College, Christ's Hospital, and the Manchester Grammar School.

4. Information was also sought from the Head Masters of the 202 Schools which appear in the Report of the Schools Inquiry Commission as possessing Endowments of over 200*l*. per annum, and from 128 of these Schools replies have been received.

Report of the Schools Inquiry Commission, Vol. I. pp. 337–435.

5. The Evidence thus placed before us conclusively proves that in our Public and Endowed Schools, Science is as yet very far from receiving the attention to which, in our opinion, it is entitled. For instance, the Returns furnished to us show that, even where Science is taught, from one to two hours' work per week may be regarded, with very few exceptions, as the usual time given to it in such Classes as receive Scientific Instruction at all. Moreover, the Instruction in Science is generally confined to certain classes of the School.

6. Among the 128 Endowed Schools from which we have received returns, Science is taught in only 63, and of these only 13 have a Laboratory, and only 18 Apparatus, often very scanty. Out of the 128 Schools, definite information has been received from 87. Of these 30 allot no regular time whatever to scientific study; 7 only one hour a week; 16 only two hours; while out of the whole number only 18 devote as much as four hours to it. The neglect with which it is treated is also clearly shown by that portion of the Assistant Commissioner's Report in which the weight attached to Science in the School Examinations is stated, whence it appears that among the higher grade Schools from which information has been received, only two attach a weight to Science in the Examinations equal to that of Classics or Mathematics; while in the case of the 128 Endowed Schools from which information has been received, only 13 give any weight at all to Science in the Examinations.

See Analysis of the Returns, Appendix V., p. 255.

7. Languages and Mathematics are by universal consent regarded as indispensable parts of a System of Education, but any System from which Science is excluded must, in our opinion, be incomplete and unsatisfactory.

8. We feel it the more incumbent upon us to insist on the Introduction of Scientific Training as an integral part of School Education, because in our Third Report we have

recommended that Students at the Universities should, at an early period, if not from the commencement of their Academical Course, be left free to choose for themselves among the principal lines of study, and should not be hampered by being compelled to pass Examinations in subjects having no direct bearing on their subsequent career. But we made this Recommendation conditionally; that is, upon the understanding that the Student should be well grounded in the principal branches of Knowledge before his entrance into the University; for while asserting that Literary Cultivation, up to a certain point, is indispensable for the Scientific Student, we expressed the opinion that, "in like "manner, evidence of corresponding Scientific Culture should be required from the "Student of Classical Literature or of Theology;" and we consider that no one should receive a Degree who has not proved himself to be well grounded in Science as well as in Languages and Mathematics.

hird eport, p. x.

Third eport, p. xi.

II. Opinions in favour of the Teaching of Science in Public and Endowed Schools.

9. Our opinion on the importance of introducing Science as an integral part of our Public School Instruction is in general accordance with the Recommendations of two previous Royal Commissions—the Royal Commission appointed in 1861 to Inquire into the Revenues and Management of certain Colleges and Schools (shortly styled the Public Schools Commission), and the Royal Schools Inquiry Commission appointed in 1864. The same view has been also adopted by the Special Commissioners appointed for the Purposes of the Public Schools Act of 1868, and the Commissioners appointed for the purposes of the Endowed Schools Act of 1869.

10. The Royal Commissioners appointed in 1861 say:—

Report, p. 32.

"Natural science, with such slight exceptions as have been noticed above, is practically excluded from the education of the higher classes in England. Education with us is, in this respect, narrower than it was three centuries ago, whilst science has prodigiously extended her empire, has explored immense tracts, divided them into provinces, introduced into them order and method, and made them accessible to all. This exclusion is, in our view, a plain defect and a great practical evil. It narrows unduly and injuriously the mental training of the young, and the knowledge, interests, and pursuits of men in maturer life. Of the large number of men who have little aptitude or taste for literature, there are many who have an aptitude for science, especially for science which deals, not with abstractions, but with external and sensible objects; how many such there are can never be known, as long as the only education given at schools is purely literary; but that such cases are not rare or exceptional can hardly be doubted by any one who has observed either boys or men. Nor would it be an answer, were it true, to say, that such persons are sure to find their vocation, sooner or later. But this is not true. We believe that many pass through life without useful mental employment, and without the wholesome interest of a favourite study, for want of an early introduction to one for which they are really fit. It is not, however, for such cases only, that an early introduction to natural science is desirable. It is desirable, surely, though not necessary, for all educated men. Sir Charles Lyell has remarked on the advantage which the men of literature in Germany enjoy over our own, in the general acquaintance which the former possess with what is passing in the scientific world; an advantage due to the fact that natural science to a greater or less extent is taught in all the German schools. To clergymen and others who pass most of their lives in the country, or who, in country or town, are brought much into contact with the middle and lower classes, an elementary knowledge of the subject, early gained, has its particular uses; and we believe that its value, as a means of opening the mind and disciplining the faculties, is recognized by all who have taken the trouble to acquire it, whether men of business or of leisure. It quickens and cultivates directly the faculty of observation, which in very many persons lies almost dormant through life, the power of accurate and rapid generalization, and the mental habit of method and arrangement; it accustoms young persons to trace the sequence of cause and effect; it familiarises them with a kind of reasoning which interests them, and which they can promptly comprehend; and it is perhaps the best corrective for that indolence which is the vice of half-wakened minds, and which shrinks from any exertion that is not, like an effort of memory, merely mechanical. With sincere respect for the opinions of the eminent Schoolmasters who differ from us in this matter, we are convinced that the introduction of the elements of natural science into the regular course of study is desirable, and we see no sufficient reason to doubt that it is practicable."

We shall hereafter refer to the Recommendations relating to Scientific Instruction made by this Commission.

Report, vol. 1., pp. 32, 33.

11. The Schools Inquiry Commission in their Report remark, as the result of their Inquiries, that the importance of Natural Science as a branch of General Education, "has received a large amount of sanction of the highest kind." "Of the Witnesses," they say, "whom we ourselves examined on this point, almost all who were not School-"masters, desired the adoption in schools of some branch of Natural Science, though, as "a rule, they did not aim at the deposition of any existing subject."

Report, vol. 1., p. 34.

And they continue, "We cannot consider any Scheme of Education complete which "omits a subject of such high importance."

"We think it established that the study of Natural Science developes better than any "other studies the observing faculties, disciplines the intellect by teaching induction as well "as deduction; supplies an useful balance to the Studies of Language and Mathematics, "and provides much instruction of great value for the occupations of after life."

12. The Regulations relating to Natural Science issued by the Special Commissioners appointed for the Purposes of the Public Schools Act of 1868 are referred to in a subsequent part of this Report.

13. The intention of the Endowed Schools Commissioners is thus expressed in the following extract from a letter addressed by their Chairman to the Chairman of this Commission on the 25th March 1871 :—

> "In all these Schools, without exception, whether for boys or girls, we propose to require as a substantial and indispensable part of their course of Instruction, at least one branch of Physical Science ; and in a few, intended for the more special encouragement of what may be called *modern* subjects, we suggest, without absolutely requiring, more extensive teaching of Science."

Appendix I., p. 13.

In accordance with this intention, the Endowed Schools Commissioners have taken steps to render obligatory the teaching of one or more branches of Natural Science in many of the Schemes which they have issued for the future management of the Grammar Schools of King Edward the Sixth, and of other Royal or Private Foundations. When the Trustees of such Endowments, or the Governors appointed under the new Schemes, have desired to build Laboratories for the Practical Instruction of the Pupils of such Schools in Chemistry or in some branches of Experimental Physics, the Endowed Schools Commissioners have, in some cases, sanctioned the appropriation to these objects of funds raised from the *corpus* of the trust estate.

14. Not only has the importance of introducing Science into our School System, as an integral and important part of Education, been urged by the four Commissions, to which reference has been made, but the good effects which have attended its partial introduction have been fully acknowledged by many Schoolmasters of great experience. Mr. Wilson, one of the Assistant Masters at Rugby School, in a paper "On Teaching Geology and Botany as part of a Liberal Education," strongly supports this view :—

> "I am quite sure that this is the first business of our profession as schoolmasters, to hold this truth strongly against all comers, that 'humanity,' and nothing else, is to be our object. We must make our teaching bear on this, give our best care to the selection of subjects, and the method of teaching, in order to make this teaching more effective. And when I urge the introduction of the sciences at the head of this paper into our course of education, I wish to make it plain that this is what they ought to be introduced into, and to this they ought to be made to contribute very effectively."

Secretary's Report : Appended Paper, No. 1, p. 63.

To this end Mr. Wilson proposes that the Elements of certain parts of Science, to which he gives the general name of "Natural History," should be taught to young boys as part of what he aptly terms the "common ground for all," and he has so well described the nature of this common ground that we quote the main parts of his sketch.

> "An orrery and globe, and a little astronomy, form the natural beginning. Let the boys make the effort involved in realizing the plan of our solar system, and our earth in space with its atmosphere mantling round it ; its kinship to the planets, its relations to sun and moon. These, and some of the common phenomena—day and night, summer and winter, eclipses, and the changes of the moon—form the natural and the old well-established introduction to science. They are still subjects of surpassing interest to every successive generation. They take boys on all their sides—memory, imagination, and reason. They show, as nothing else shows, the connexion of cause and consequence. And there is a genuine and deep satisfaction, a real pleasure of the intellect, which boys attain when they first understand the causes of these common great phenomena. They stand thenceforward on a higher platform. The universe presents to them not a mere wonderland but a reign of law. These are the *literæ divinæ* written in the universe by the finger of God."
>
> "Then we pass to the great earth itself, and all its activities ; the effects of its still remaining internal heat, its volcanoes and earthquakes, the slow oscillations of level, and the great changes slowly taking place in the familiar outline of the continents and islands, and the proofs still visible of past changes. These things must be well thought out by the class, and illustrated and brought home to them by pictures and specimens. The effect of the attraction of the sun and moon in making tides, and their geological and cosmical action, is a matter that can be to some extent grasped, though so difficult in its complete theory ; and is far too important and common a phenomenon to pass by without notice. And then come the complicated consequences of solar heat and light. It is with peculiar interest and pleasure that a boy learns the causes of winds and currents, of trade winds and cyclones, of evaporation and rain, and its distribution on the earth. There is a sense of power obtained by finding out that these great and familiar phenomena are subject to laws, and are not primary facts. And all these are matters, towards which it is only necessary to guide the thoughts of the boys, and they can, with very little help, think them out for themselves. I find it rarely necessary to give a regular explanation of anything, except as a kind of *résumé* of the suggestions thrown out by the class, and successively criticised. Fresh information as to fact must of course be given, when it is seen to be wanted, and not before. And this incidentally gives them a much higher respect for knowledge and the value of facts than they had before. The labours of observers, and mathematicians, and collectors are seen by the class in their rue light, as contributing to the store of accurate knowledge in regions more or less inaccessible to themselves."
>
> "The consequences of these activities must then be traced out. And these constitute the principles of Geology. To teach them is not hard ; a large stock of pictures, photographs, &c., will be found very useful. We take the work of rain and rivers ; their solvent and transporting powers, and straightway the ravine and the waterfall, the rich plain, and the whole river valley, with its wondrous system of drainage, are seen to be the consequences of the familiar forces at work all round us. The work of the sea is easily understood, and behold the map of England is looked at with new eyes ; there must be a cause for every bay and headland. The formation of marine deposits, the growth of coral, and Darwin's explanations of the form of coral

Ibid., p. 65.

islands: the ooze of the Atlantic, the work of frost and snow, the glacier and iceberg, the geographical distribution of plants and animals, all are intelligible, and all, if I may so call it, exciting; they excite to further reading and a good deal of thought; they show, moreover, the regions of knowledge; the necessity of chemistry, and meteorology, and astronomy, and zoology is really felt, without being stated in so many words."

After some further illustrations of his method of teaching Geology, Mr. Wilson continues:—

"It may seem to some that the amount of positive knowledge gained is too little; and indeed it is not much, not as much as would be gained by half the time spent in learning and being examined on somebody's advanced text-book. But from the one system the boy emerges hungry for more knowledge, and his own reading will supply his wants; he emerges with a clear understanding how science grows, and what it is, and has a framework in which he can fit all knowledge he subsequently acquires; while from the other he comes out—perhaps some of my hearers know how he comes out."

"I know of no single book which contains all these subjects. The teacher, at any rate, *must* draw his knowledge from many books, and from real, personal knowledge of his subject. Methods of teaching are very important, but the teacher is of far more importance; and no teaching of these or any other subject is likely to be worth much unless the teacher is thoroughly master of his work, has made it his own by viewing it in various lights, and is independent of any text-book, or any order of viewing nature. He cannot be too discursive in his reading or varied in his attainments; and if he is further able to be prosecuting some original work, however humble, in which his pupils can assist him, they will learn more of the true scientific spirit by contagion than they will gather from the most eloquent lectures."

* * * * * * * * * *

"I do not see any reason for doubting that these subjects are the best for early education, say from the ages of twelve to fourteen. At such an age, chemistry or physics cannot be understood, except in the rarest cases. I know that Faraday expressed an opposite opinion. But Faraday loved the children, and never examined them. These subjects, especially the geological course, as I have explained it, give a solid foundation of familiar facts, which form the basis of subsequent scientific knowledge. And they attract the strongest and finest minds, which is not found to be the case with all branches of science."

"It may be urged that this teaching cannot be *thorough*,—that boys will be brought in contact with chemistry, physics, mechanics, mathematics, at an age when they cannot understand them; and the result will be, to turn them out capable of talking *about* a great many things, and knowing *theories* about a great many things, but without the rigorous training necessary to enable them to judge of these theories."

"This is, of course, partly true. But it is no objection. The logical order of ideas is not the educational order. A boy learns to read, and make out the meaning of a storybook before he learns grammar, which might be said to precede logically; he reasons before he can learn logic; and so he has to learn a thousand things by experience and observation and reading and conversation, which form the material out of which science grows. The teaching is thorough *so far as it goes*, and it is delusive to suppose that the teaching of mechanics or physics can be made exhaustively thorough to a boy. He apprehends only by comparison of one thing with another; and where experiment takes him out of the range of his experience, there his conclusions are not his own, but his teacher's. These subjects, which may be put aside as mere scientific information, have a double value, stimulative and intellectual, that no one who has not tried them can well estimate. They would plainly be incomplete by themselves; they do not admit, taught in this manner, of the careful study of detail, the minute and painstaking work and drudgery, that makes every science so valuable as an instrument of education. But these subjects claim to enter into the schemes of literary and scientific education; to form a common ground between them; to be science to the men of literature and literature to the men of science."

15. Whether the topics of Elementary Scientific Instruction should be taken in the precise order indicated by Mr. Wilson, or in some other, is a point on which we do not express an opinion; but we desire to draw attention to the fact, that it is the opinion of some able and experienced Schoolmasters, and that of previous Commissions, as well as our own, that such Instruction in Elementary Science ought to be given, and that there is no real obstacle to its being given, in the early years of school life.

III. Discussion of the Difficulties attending the Introduction of the Teaching of Science into Public and Endowed Schools.

16. In spite of this concurrence of authority in favour of the Introduction of Science into Schools, it appears that not one half of the 128 Endowed Schools from which returns have been received have even made an attempt to introduce it; and, of these, as we have already stated, only 13 have a Laboratory, and only 10 give as much as four hours a week to these subjects.

17. The neglect of Recommendations of so weighty and authoritative a character should imply the existence of strong grounds of excuse. The chief of those given for the omission of the Teaching of Science in Schools are—(1.) the Absence of Funds; (2.) the Uncertainty as to the Educational Value of Science, particularly in the case of young Pupils; (3.) the Difficulty of finding Time for a New Study in an already overcrowded Curriculum.

Secretary's Report: Appendix, p. 73.

18. The absence of funds, no doubt, places very serious difficulties in the way of some of the smaller Foundations; but experience shows that satisfactory results in Science Teaching may be produced at a very small expense. On this subject we may refer to Mr. Tuckwell's account of the limited means with which it was commenced and carried on with success at Taunton.

19. We think that this account conclusively proves that the apparatus requisite for Elementary Science Teaching can be provided at a comparatively trifling cost; and that, where there is a good Teacher, the makeshift character of the appliances need not prevent efficient Teaching. On the other hand, it is important to remember that the introduction of new subjects of study implies the introduction of Teachers qualified to take charge of them; and that in many of the smaller and more poorly endowed schools to which we are now referring, there is great difficulty in obtaining the funds requisite for the payment of additional or increased salaries. At the same time, it must be regarded as certain that no school which is forced to plead its poverty as an excuse for the neglect of Natural Science, can pretend to complete efficiency, or can adequately meet the Educational Requirements even of its own locality.

20. When the income of a School is small it may not be possible to provide an adequate stipend for an Assistant Master employed only in Scientific Instruction. Moreover, the number of pupils may not be so great as to justify such an appointment. It is, therefore, important that at least one Master should combine, with the qualifications necessary for his success in teaching Literature, such knowledge and skill as may enable him to give Practical Instruction in Natural Science. No doubt this combination of Literary and Scientific Knowedge with Practical Skill in conducting the Instruction of Classes is at present rare, and it is very desirable that a Systematic Preparation for such Teachers should, if possible, be provided.

21. With reference to the wealthier Foundations, and the great Proprietary Schools, the want of funds cannot be properly alleged as a reason for not providing appliances proper for the Teaching of Natural Science. Indeed, there is already considerable evidence of improvement in this respect. Laboratories have been built, or are in the course of construction, at Eton, Harrow, and Rugby; and there is reason to hope that the example will be generally followed, as the Special Commissioners appointed for the Purposes of the Public Schools Act of 1868 have included in their Regulations a Clause requiring the Governing Bodies of the nine Public Schools to which their powers extended to provide and maintain Laboratories and Collections of Apparatus and of Specimens. We desire to record our opinion that School Laboratories should be constructed so as to supply accommodation for Practical Work in Physics, as well as in Chemistry. It will be seen from the Secretary's Report that many persons of experience in education have arrived at the conclusion that Chemistry is not so well fitted for the practical instruction of young pupils as Physics. Without attempting to decide this disputed question, we would express our conviction that neither of these forms of practical work ought to be neglected in School Teaching.

22. It is generally admitted that a sound knowledge of the Sciences of Observation and Experiment cannot be acquired from the study of Text Books alone; and that oral teaching, accompanied by appropriate illustrations and experiments, is indispensably necessary. But even such oral teaching has been found by itself to be insufficient; and, in our judgment, no System of Scientific Instruction can be regarded as satisfactory which does not familiarise the learner with the methods of observation and experiment, by making him practise them himself, whether in the field or in the Laboratory.

23. As the organization in a large School of Practical Instruction in Physics has appeared to offer some difficulties, we would refer to the Secretary's Report for an account of the advantages attendant upon the arrangement adopted by Professor Pickering at the Massachusetts Institute of Technology in Boston.

Secretary's Report, § 11, Appendix, pp. 36–43.

24. We regret to observe that in many of the Larger Schools the number of Science Masters is totally inadequate. The Special Commissioners have found it necessary to insist that there should be at least one Science Master for every 200 boys; a provision which appears to point to a still greater deficiency at present. Until this state of things is remedied, no considerable improvement can be expected in the Standard of Scientific Education at present prevailing in English Schools. We fear that the fewness of the Science Masters in the great Public Schools, and the slowness with which their number is allowed to increase must, to a certain extent, be attributed to an inadequate appreciation, on the part of the Authorities of those Institutions, of the importance of the place which Science ought to occupy, and which the country desires it should occupy, in School Education. But we are also disposed to believe that the difficulty of disturbing existing arrangements, and the increased expense entailed by additions to the staff of Masters, are among the principal causes of the delay in remedying an evil of such magnitude. It might seem, at first sight, that the provision of an adequate number of Science Masters ought not to involve any heavy charge upon the income of a

large school; because, in proportion as the time of the pupils is occupied with Natural Science, fewer teachers of other subjects would be required. It has, however, been found in practice that whenever the subjects of instruction in a school become more varied, the whole number of persons employed in teaching has to be increased. But as there is a well-founded impression that the large English Schools have suffered from being insufficiently supplied with Assistant Masters, we cannot regard it as any disadvantage that a more general introduction of Natural Science Teaching would call for an increase in the number of such Assistants.

25. We have alluded to the difficulty of providing for schools, which have slender incomes, Assistant Masters who have both adequate Literary and Scientific Knowledge, and the requisite skill in Class Teaching and Practical Instruction. Even for the great Public Schools much difficulty is experienced in obtaining the services of Science Masters fitted to form part of their staff. The Head Masters naturally look to the Universities to supply them with Assistant Masters; but the number of University Students of Science is still so limited that the supply falls short even of such demand as exists at present. These several considerations support the suggestions recently made by the Head Masters of Public Schools at their Annual Conferences, that means should exist—and, if possible, within the Universities—enabling young men, who intend to devote themselves to the Scholastic Profession, to pass through a Course of special preparation for it, and to obtain a Certificate of the nature and extent of their qualifications. By such means adequate knowledge and practical skill, both in class teaching and in manipulation, would be ensured.

26. With regard to the second objection, it is obvious that all branches of Science do not possess an educational value of the same kind; and we are not prepared to assert that the mere communication to the mind of the pupil of the facts of Science would contribute very materially to the training of his intellectual powers, although it may supply him with much valuable information, and may render him the still more important service of awakening his desire for further knowledge. But the true teaching of Science consists, not merely in imparting the facts of Science, but in habituating the pupil to observe for himself, to reason for himself on what he observes, and to check the conclusions at which he arrives by further observation or experiment. And it may well be doubted whether, in this point of view, any other educational study offers the same advantages for developing and training the mental faculties by means of a great variety of appropriate exercises. In the Lower Forms of our Public Schools, the youth of the scholars must of course be taken into consideration in the nature of the instruction given, but we nevertheless think it of great importance that the introduction of Science into Education should take place at a very early stage. Elementary Science is certainly not more difficult, and to most young persons is more interesting, than Arithmetic or Grammar, and the most eminent men of Science, as well as some most successful Teachers, are of opinion that there is no reason to apprehend any difficulty in this respect. The Evidence which we have received on this point is very strong; and its force is not diminished by the fact that much of it relates to Primary Schools.

Qu. 2781. 27. Sir W. Thomson, Professor of Natural Philosophy in the University of Glasgow, on being asked :—

> "At what age do you think it desirable that the teaching of elementary science in our primary schools should be commenced; in fact, how young do you think a child could, with any profit, commence instruction in elementary science?"—

Replied,

> "I think that at 12 or 14 the commencement of teaching in some branches of science would be very advantageous. I scarcely think before 12; but I think that boys of good intelligence might be very advantageously introduced to much of natural science at 12." Qu. 2782.
>
> "Then I am afraid that would almost exclude natural science from the primary schools of the country, because we can hardly hope to keep children there after 14?—No; I scarcely like to adhere to any such answer, except in respect to the more abstract branches. For instance, higher mathematics and dynamics may be very advantageously commenced at 12; but I doubt whether there can be much advantage in commencing such subjects before 12. But there is a great deal of general knowledge in natural history, and geography, and chemistry, which I think could be imparted very advantageously indeed to boys of considerably younger age than 12."

28. Professor Ramsay, Director General of the Geological Survey of the United Kingdom, of the Museum of Practical Geology, and of the Mining Record Office, thus states his opinion regarding the elementary part of Astronomy and Geology :—

> Qu. 605. "At what age do you think that a boy might advantageously be instructed in the elementary facts of geology?—I think they might begin at an exceedingly early age, in the same way that all children who have any education at all, for example, know some of the elementary points of astronomy, so certain questions involving geological knowledge might be instilled into them."

“Would you do that by means of the aid of specimens and plans, and the like, and not merely books?—Not merely books, but by the aid of specimens and by the generally better educated state of the whole of the public. It might be part of a household education, quite irrespective of the teaching in schools, if scientific education in the country were placed on a proper footing.” Qu. 506.

29. Dr. Rolleston, Linacre Professor of Physiology in the University of Oxford, says:—

“I would certainly cause a boy to begin acquaintance with scientific matters much earlier than that [the age of 16], for the faculty of observation, the power of observing, is in all its vigour long before 16. Long before the faculties of reflection and ratiocination are in anything like ripeness the faculties of observation are well developed. A boy, I should say, at 11, or certainly 12, might be put through certain of the classificatory sciences, or one at least, viz. botany, and he might have a training in physics and a training in chemistry, and all boys alike should have some training in these before 16.” Qu. 3719.

30. Canon Cromwell, Principal of St. Mark’s College, Chelsea, insists on the importance of introducing the Elements of Physical Geography and other parts of Natural Science into Primary Schools:—

“Understanding by primary schools those in which boys are generally under 13 years of age and above seven, I know by experience that the elements of physical geography can be very well taught almost throughout the school. The first step in geography should be made in physical geography, and one advantage possessed by this subject from an educational point of view is this, that almost everything in it can be presented to a child in a concrete form. He may learn something about the principles of heat, about air and water, about natural history, and the action of the elements upon the surface of the globe. He can have illustrations of those things pointed out to him in his own neighbourhood almost, wherever he is. It seems to me that it is the best introduction to any knowledge of physics that might be hereafter required. Wherever the teacher had a special bent for chemistry he might illustrate what he had to say about the laws of physical geography by his knowledge of chemistry. If, again, he were a man who took great interest in natural history or botany, he would dwell more upon those portions of the subject. Physical geography connects itself with almost the whole circle of what are called the physical sciences. I know that children and young men also take great interest in the subject, and what they take great interest in, they learn quickly.” Qu. 7982.

* * * * *

“You think also that a certain amount of information in natural science could be given in elementary schools?—A certain amount of an elementary character, remembering that it must always be given in a concrete shape with plenty of illustrations. For example, experiments can be exhibited to children illustrating the properties of heat, by taking a common bladder and putting it before the fire, and showing how the bladder fills and bursts, or by taking a bar of iron and putting it into the fire and heating it. Such common experiments are things which boys can easily comprehend. In the same manner, I think, they should be familiar with some of the simple machines and instruments, which could be explained to them by ordinary models, and they should know something about the common properties of matter, something about the different forms of attraction—chemical attraction, capillary attraction, and so forth. All this would be useful to boys of almost all classes, whether in town or country.” Qu. 7985.

31. Mr. Jarmain, Teacher of Science at the Mechanics’ Institute, Huddersfield, answered several questions bearing on the subject:—

“If I remember right, in the evidence which you gave before Mr. Samuelson’s Committee in the House of Commons, with reference to elementary schools, you expressed an opinion as to its being perfectly possible to teach a certain amount of elementary science in the elementary schools of the country?—Yes, to the upper classes of the school. I tried the plan during the time that I had a school, and I found it to answer very well.” Qu. 8922.

“From the age of 11 to 13?—Yes.” Qu. 8923.

“That is a point which you feel no doubt upon whatever?—I feel no doubt upon it whatever.” Qu. 8924.

“Did you try it in chemistry?—Yes.” Qu. 8925.

“But, I presume, you would consider that there would be no more difficulty in applying it to botany or physiology than in the case of chemistry?—No, I do not.” Qu. 8926.

“Do you think that the teaching of one or two such subjects would in any way interfere with the instruction of children in the elementary subjects of reading, writing, and arithmetic?—No, I do not think it would. I think that the pupils would like it very much. As a rule, boys very much like scientific instruction.” Qu. 8927.

“It would give them, would it not, a greater interest in their school education, as a whole?—Yes, I think so.” Qu. 8928.

“And, in that way, would have a decidedly favourable influence upon their reading and writing?—In two classes that I have at the Huddersfield College and the Huddersfield Collegiate Institution, the boys who are in the chemistry class I find to be the best boys in the school in other subjects.” Qu. 8929.

32. Mr. Shore, Organizing Master of the East Lancashire Union of Evening Schools, expresses a similar opinion:—

“I think that all the great principles of physical geography might undoubtedly be taught to boys in the day school at 10 years of age.” Qu. 2276.

33. The Evidence laid before the Public Schools Commission by Dr. Carpenter, Professor Faraday, and Dr. Hooker, is so entirely in harmony with these views that we quote it in part here.

34. Dr. Carpenter speaks strongly on the importance of introducing into Education at an early period subjects of a less abstract character than Grammar and Mathematics.

“65. Do you think that the mind, ordinarily speaking, is as apt for the exercise of its faculties upon the subjects of natural science as upon grammar and mathematical subjects, at the early period of life?—I should say more so; that it is more easy to fix a child’s attention upon something which it sees, than upon an abstraction.” Minutes of Evidence taken by Public

Schools Commission, Part 2, p. 366.

"66. Do you think that in that point of view, in fact, it is so far a subject better calculated to call out a healthy action of the reasoning powers than the more abstract subjects of grammar and mathematics?—I think it is, at the early period. I think that a lad of from 10 to 12 years of age is better fitted to be led to observe and reason upon what he observes in objective phenomena, than he is to reason upon abstractions. I think that from say 12 years of age, the powers may be healthfully exercised upon abstractions; but as far as I can judge, a child in learning a language learns by rote purely or almost purely up to say 12 years of age, but after that he begins, if he is well taught, to understand the *rationale* (so to speak) of the rules, but it is a mere matter of memory with him up to that time."

35. Professor Faraday thus refers to his own experience:—

Minutes of Evidence, Part 2, p. 378.

"46. I understand you to say, that you do not feel in a position to define exactly at what age it might be desirable to introduce the physical sciences?—I think one can hardly tell that until after experience for some few years."

"47. Or whether you would introduce it at an early age concurrently with classical instruction?—I would not undertake to say. All I can say is this, that at my juvenile lectures at Christmas times I have never found a child too young to understand intelligently what I told him; they came to me afterwards with questions which proved their capability."

"50. If you take a little boy of ordinary intelligence, 11 years old, at Eton, and, say, half his time is devoted to classics and the other half to any branch of physical science, what would you teach him?—I would teach him all those things that come before classics in the programme of the London University,—mechanics, hydrostatics, hydraulics, pneumatics, acoustics, and optics. They are very simple, and easily understood when they are looked at with attention by both man and boy. With a candle, a lamp, and a lens or two, an intelligent instructor might teach optics in a very short time, and so with chemistry. I should desire all these. There might be a door by which you could leave out those for which they were inapt."

"51. You would not be frightened by the hard words?—I do object very much to the too frequent use of hard words or technical phrases either in chemistry or in other subjects. The hard words are not the things. But the result will depend more on the men who are the teachers than on the wording itself. Education should not be stopped by that."

Minutes of Evidence, Part 2, p. 382.

36. The same Commission received from Dr. Hooker an interesting account of the successful attempt made by Professor Henslow to introduce the study of Botany into a village school. Professor Henslow thought that—"It was the most important " agent that could be employed for cultivating their faculties of observation and for " strengthening their reasoning powers. * * * * It was also the opinion of some " of the Inspectors of Schools who came to visit him, that such children were in general " more intelligent than those of other parishes, and they attributed the difference to " their observant and reasoning faculties being thus developed."

The ages of the children varied from 8 to 14; the class, which was a voluntary one, mostly consisted of girls; and the children are said to have learnt the subject readily, and to have been exceedingly fond of it.

37. This Evidence leaves no doubt upon our minds that Elementary Scientific Instruction might be given with great advantage from the commencement of the school career.

38. The third of the difficulties most frequently urged is want of Time. While we cannot deny the reality of this difficulty, it seems to us to offer no justification whatever for the total or almost total exclusion from Education of any great branch of Human Knowledge. The difficulty is one which can only be met by carefully economizing time, by employing the best methods of teaching, and by discarding superfluous subjects of study. To meet it by making education one-sided and incomplete, cannot be for the interest of the pupil. Nor does it appear to us impossible to make a fair adjustment between the claims of the different branches of Instruction. The number of hours of study in our Public Schools may be taken at not less than 35 per week, including in the estimate the number of hours on an average employed in preparation. Now, if six hours per week be devoted to Science, and if we suppose six hours also to be given to Mathematics, there would still remain at least 23 hours a week for the study of Language and other subjects.

39. We are not prepared to admit that the classical Scholarship of the Pupil would, by the close of his school career, have suffered in consequence of the subtraction of the 12 hours which we have assigned to Mathematics and Science: since we believe that the influence of Instruction in Natural Science on the development of his intellectual powers might be such as to promote his success in Classical Learning. Be this as it may, it is quite certain that his Education, if confined to one class of subjects, would be an unbalanced one, that his intellectual tastes and powers would have been developed in one direction only, and that so far he would be the worse prepared, whether for the continuance of study, or for the active business of life. We have already expressed the opinion that the Student who has given evidence that he possesses a fair amount of both Literary and Scientific Culture, may with advantage be allowed to choose for himself among the main lines of study pursued at an University. But, while he is still at school, and before he can have given such evidence, we do not think that the same liberty of choice ought to be conceded.

IV. Recommendations of the Royal Commission of 1861.

40. The Royal Commissioners of 1861, while advocating Science Teaching, recommend that " Arrangements should be made for allowing boys, after arriving at a certain place " in the school, and upon the request of their parents or guardians, to drop some portion " of their classical work (for example, Latin Verse and Greek Composition), in order to " devote more time to Mathematics, Modern Languages, or Natural Science; or, on the " other hand, to discontinue wholly or in part Natural Science, Modern Languages, or " Mathematics, in order to give more time to Classics or some other study." Recommendation XIII.: Report, p.53.

41. We confess that, in our opinion, such options should be exceptional and confined to the very highest divisions of the schools, as we regard Science, Language, and Mathematics as essential subjects of education up to the age at which boys leave school.

42. The same Commissioners also say :—

" We think it essential that every non-classical subject (except music and drawing), in every part of the school in which it is compulsory, should affect the promotion from one classical form to another, and the place given to each boy in such promotion, as indeed in certain instances is already the case with respect to Mathematics and some other subjects. Thus, if Natural Science is compulsory on all boys in the fourth and fifth (Classical) Forms of a School, each boy's proficiency in Natural Science should contribute, according to a certain scale of marks, to the rise from the fourth form to the fifth, and from the fifth to the form next above it, and should also help to determine the place assigned him, on each promotion, in his new form." Report, p.35.

" A scale of marks for this purpose should be settled by the Governing Body, or by the Head Master with the approbation of the Governing Body, and amended, if necessary, from time to time."

" It is essential that the scale should be such as to give substantial weight and encouragement to the non-classical studies."

" The following approximation to a scale is suggested as indicating the relative weight, which, in our opinion, may fairly be assigned to the various subjects."*

" Classics, with History and Divinity, not less than $\frac{4}{8}$ nor more than $\frac{5}{8}$, Mathematics, not less than $\frac{1}{8}$ nor more than $\frac{2}{8}$; Modern Languages, not less than $\frac{1}{8}$ nor more than $\frac{2}{8}$; Natural Science, $\frac{1}{8}$—$\frac{2}{8}$; the three non-classical subjects combined $\frac{4}{8}$."

V. Regulations issued by the Special Commissioners.

43. The Special Commissioners appointed for the Purposes of the Public Schools Act of 1868 have recently issued Regulations for all the Schools to which that Act applies.

44. The Regulations for Eton, so far as they relate to Mathematics and Natural Science, are as follows :—

" 3. In any examination determining the position of a boy (not being one of the senior boys) in the School, or in any report of a general examination, the proportion of the marks to be assigned to Mathematics shall be not less than one-eighth, nor more than one-fourth, as the Governing Body shall think fit.

" 4. In any examination determining the position of a boy (not being one of the senior boys) in the School, or in any report of a general examination, the proportion of the marks to be assigned to Natural Science shall be not less than one-tenth, nor more than one-fourth, as the Governing Body shall think fit.

" 5. In any examination of senior boys, the proportion of marks to be assigned to the several subjects of study shall be determined by the Head Master, with the approval of the Governing Body.

" 6. The Governing Body shall from time to time determine the point in the College list above which the boys shall be reckoned as senior boys for the purposes of these Regulations.

" 7. There shall be one Mathematical Master, at the least, for every 100 boys in the school; and there shall be one Science Master, at the least, for every 200 boys learning Natural Science in the School. All such Masters shall rank as Assistant Masters of the School.

" 8. Every boy shall learn Natural Science continuously from his entrance into the Remove until he become one of the senior boys in the School, unless his parent or guardian express in writing a desire for his exemption from this Regulation.

" 9. The Head Master shall give facilities so far as he shall think practicable to any senior boy, at the request of his parent or guardian, to pursue any particular subject or subjects of study as may be deemed most expedient for him, and to discontinue any other subject or subjects of study for that purpose.

" 10. The Governing Body shall, as soon as possible, provide and maintain out of the income of the property of the School, or out of any other means at their disposal for the educational purposes of the School, laboratories, and collections of apparatus, and of specimens.

" 12. Any boy entering the School above the age of 12 shall have the opportunity of showing acquaintance with Botany, Physical Geography, or some other branch of Natural Science, and with Arithmetic, or Mathematics, in the entrance examination for the School.

" 13. Any boy in the School above the age of 12 who may evince an aptitude for Natural Science, shall have facilities for that study."

---

* " In this . . . . scale of marks . . . . it is assumed that all the branches of the course are being pursued together. Some variation would be necessary in applying the scale to parts of a school in which this was not done."

45. The Regulations for the other Schools to which the Powers of the Special Commissioners extended are of a similar character, and, as will be seen, the Teaching of Science is left open as regards the more juvenile part of the School, not being compulsory until boys reach a part of the School which they usually attain at about the age of 13.

Conclusions and Recommendations.

46. On a review of the present state of the Public and Endowed Schools, it appears to us that though some progress has no doubt been achieved, and though there are some exceptional cases of great improvement, still no adequate effort has been made to supply the deficiency of Scientific Instruction pointed out by the Commissioners of 1861 and 1864. We are compelled, therefore, to record our opinion that the Present State of Scientific Instruction in our Schools is extremely unsatisfactory. The omission from a Liberal Education of a great branch of Intellectual Culture is of itself a matter for serious regret; and, considering the increasing importance of Science to the Material Interests of the Country, we cannot but regard its almost total exclusion from the training of the upper and middle classes as little less than a national misfortune.

47. While appreciating the reasons which may have induced the Special Commissioners not to insist, in Regulations which have the force of a Statute, on the introduction of Science in the junior parts of the Schools, we desire to express our own opinion that Scientific Instruction ought to commence from the beginning of the school career.

48. Moreover, while we are sensible that much discretion must be left to the Governing Bodies of Schools, and are, therefore, not surprised at the latitude allowed by the Special Commissioners, we think that the Governing Bodies would do well to adopt not the minimum of one-tenth of the marks, but a larger proportion, say one-sixth.

49. We, therefore, Recommend,

1. That in all Public and Endowed Schools, a substantial portion of the time allotted to study, should, throughout the School Course (but subject to the exceptional options to which we have before referred), be devoted to Natural Science; and we are of opinion that not less than six hours a week on the average should be appropriated for the purpose. Para. 41.

2. That in all General School Examinations not less than one-sixth of the marks be allotted to Natural Science.

3. That in any Leaving Examination, the same proportion should be maintained.

All of which we humbly beg leave to submit for Your Majesty's gracious consideration.

(Signed) DEVONSHIRE.
LANSDOWNE.
JOHN LUBBOCK.
JAMES P. KAY-SHUTTLEWORTH.
BERNHARD SAMUELSON.
W. SHARPEY.
THOMAS H. HUXLEY.
HENRY J. S. SMITH.

In signing this Report, I feel compelled to say that I regard the first Recommendation as too inelastic. While fully admitting that Natural Science ought to form a substantial part of a liberal education, I am not prepared to recommend that in *all* Schools the study of Natural Science should be carried on throughout the School course, but wish a wider discretion to be left to the Governing Bodies, or Head Masters, as to the degree to which what has been called the "stratification" of studies should be carried out.

G. G. STOKES.

J. NORMAN LOCKYER,
Secretary.

June 18th, 1875.

APPENDICES.

LIST OF APPENDICES.

	PAGE.
APPENDIX I. Letter from the Endowed Schools Commission - - - -	13
APPENDIX II. Secretary's Report on the Teaching of Science in certain Public and First Grade Schools; together with Appended Statements - - - -	14–93
APPENDIX III. Replies to Secretary's Letters, dated July 22nd, 1870, and September 27th, 1872, with regard to the Teaching of Science in Schools - - - -	94–199
APPENDIX IV. Honours gained at the Universities by Science Students from the various Colleges and Schools - - - - - - - -	200–206
APPENDIX V. Returns from the Head Masters of certain Endowed Schools in England and Wales for Secondary Education - - - - - - -	207–255

APPENDIX TO SIXTH REPORT.

APPENDIX I.

LETTER from the ENDOWED SCHOOLS COMMISSION.

"2, Victoria Street, S.W.,
"MY LORD DUKE, 25th March 1871.

"1. YOUR Grace may, perhaps, think it convenient that the substance of what passed at the interview which we had the honour to hold with your Grace and some of your Colleagues on the 6th inst., should be recorded for further use and reference: and I, therefore, proceed to make a brief statement of the principles upon which we are acting in preparing schemes for the better management and application of educational endowments, so far as scientific instruction is concerned.

"2. Our schemes may broadly be divided into those which regulate schools giving elementary instruction only, and those for schools giving higher instruction.

"I speak first of this latter class. It contains many schools of very various character, varying from what are little above the elementary schools, to others which are just subordinate to the Universities. In all these schools, without exception, whether for boys or girls, we propose to require, as a substantial and indispensable part of their course of instruction, at least one branch of physical science; and in a few, intended for the more special encouragement of what may be called *modern* subjects, we suggest, without absolutely requiring, more extensive teaching of science. We are prepared, also, in particular cases, to recommend the establishment of schools of a more specifically scientific or technical character, provided that either the endowments to be applied to this purpose are not restricted by their present trusts to particular localities, or such a school appears likely to be regarded by the locality as more beneficial than one of more general instruction.

"3. Our schemes always provide for the payment of school fees by the majority of the scholars, and the grant of free, or half free, places to a certain percentage, selected by competition either in the school work, or in a special examination, or in both.

"Wherever the endowment is sufficient, we think that further help to boys of merit and ability should be provided in the shape of exhibitions, tenable at some higher school, or at the University, or at some other place of liberal or professional study. In schools immediately above the primary schools, and especially in populous places, we very frequently restrict the competition for a certain number of the free places to scholars from the primary schools of the district, and in these cases, particularly, we endeavour to provide for further assistance being given to meritorious scholars, so as to enable boys of humble means to continue longer at school than could otherwise be expected.

"4. We do not as a general rule go further into particulars in the scheme. It appears to us wisest to constitute the best governing bodies that we can, and then trust to their intelligence and conscientiousness to carry the scheme into effect, subject to the ordinary tribunals. It is, no doubt, competent to us to apportion the exhibitions and other prizes which the endowment will bear between the several subjects of study, and to specify the precise weight which shall be assigned to science, or any other subject, in estimating the result of a competition; and where the number of exhibitions or free places to be provided by an endowment are considerable, we may very probably sometimes adopt this course. But, in the main, we think it safer to put no fetters on the governing body which may prevent their adjusting the details to suit the local circumstances, so as to work most effectively from time to time on the varying energies of the school.

"5. We have it now under serious consideration, whether, considering the great benefit which has been devised for elementary instruction from the establishment of training colleges for teachers, we may not most materially assist secondary education by providing some analogous institution for those who are to be teachers in secondary schools. If we should eventually decide upon such a course, we should probably find instruction in science teaching to be one of the most promising, as it is one of the most neglected subjects of special preparation.

"6. I turn now to the case of schools for elementary instruction. Endowments for such purposes are included within our jurisdiction, just as much as endowments for higher instruction, or attached to higher schools, with the exception of such as belong to schools which, at the date of the passing of the Endowed Schools' Act (2nd of August 1869), were in receipt of an annual Parliamentary Grant. But the action of the Education Department influences elementary schools so powerfully and so beneficially, and is so likely to attract nearly all schools of the class within its range, that we think it clear that we must deal with endowments applicable to such schools on somewhat different principles from those on which we proceed in the case of others. The Department takes minute cognizance of these schools, inspects them regularly, virtually prescribes their course of study, and the character and qualification of their teachers. We cannot, therefore, wisely prescribe in these schools the teaching of any particular subject, as, for instance, science; but we may, after full consideration of the new code lately isued by the Education Department, see our way to securing a beneficial application of endowments, either by establishing a higher department in the elementary school, in which science should be taught, or by providing teachers of science in common for several schools in a district, or by science exhibitions or prizes, or by giving funds for the supply of proper instruments and apparatus. It certainly seems that no fitter use can be now found, whether for endowments which have through the action of the Legislature ceased to be needed for ordinary elementary teaching, or for non-educational endowments converted under section 30 of the Endowed Schools' Act to educational purposes, than the better promotion of all such knowledge as bears directly upon the industrial occupations of the people, but is not adequately encouraged by other means.

"7. I have spoken above of the large discretion which we purpose giving to the governing bodies created by our schemes. Their constitution is one of the most difficult, as it is one of the most important parts of our work. The scheme prescribes, within certain fixed limits, the general character of the school which is to be administered, and the general purpose to which an endowment is to be applied. The constitution of the governing body is framed with reference to the character of the school, and we then leave the duty of selecting the governors to various constituencies without restricting their discretion, so as to secure any special representative of science, or of any other branch of instruction. The details of the instruction we leave to the control of the head master.

"8. Your Grace will see from the above account that our schemes, broadly speaking, do little more than decide who shall apply the endowments, and what objects shall be kept in view in their application. But the future success of the schemes will depend on the manner in which they are worked. And when new subjects are being introduced into the school course, it is especially desirable that accurate information should be easily obtainable as to the best methods and appliances for working them. This information is desirable, not only for the governors, that they may adopt and provide them, but also for us, that we may give the governors the requisite powers. It will give us much greater confidence in prescribing the teaching of science, and give us much greater hopes of conciliating general support to our proposals, if the proposals are supported, and the best means of executing them defined and explained by the high authority of your Grace's Commission.

"9. I venture briefly to specify some of the points which seem to us especially to require illustration, and which it may, perhaps, be within the scope of your Grace's Commission to consider. They require to be considered in reference both to the several grades of schools, viz., those in which the scholars are intended to complete their education by the age of 15, those in which they are intended to continue till 17, and those in which they do not complete their education before the age of 19, or thereabouts; and, also, in some cases, to the varying circumstances of town and country. These points are:—

"(*a*.) The relative educational value of the different branches of science.

"(*b*.) The age at which children are best fitted to begin such studies.

"(*c.*) The amount of time which, on a fair view of the time at the disposal of the several schools, may be fairly claimed for physical science; and what subjects now forming part of the school course might be displaced with least loss, in order to make room for the new studies. The Commissioners are of opinion that the subject which in many schools might give way with least disadvantage is Greek; but the matter is one eminently deserving attentive consideration.

"(*d.*) The best methods of teaching science, and the appliances necessary for its effectual development, with the size and cost of laboratories, instruments, models, books, maps, and the like, suitable for larger and more expensive, as well as for rural and poor schools.

"(*e.*) The present, and probable future sources of supply and cost of well-qualified teachers; and the expediency of establishing institutions to train such teachers, whether separate or as branches of general training colleges for teachers above those of elementary schools; or, again, as appendages to large schools in which science is taught.

"(*f.*) The need of encouragement, subsequent to school life, for the study of science, either by way of bare examinations, or of scholarships at the Universities or elsewhere, or of admission to public posts, *e.g.*, through the Indian and Home Civil and Military Service Examinations.

"(*g.*) The need of special institutions, such as Technical Colleges, corresponding to Theological Colleges for the clergy, or Woolwich and Sandhurst for the army, for the prosecution of scientific studies after school.

"I have the honour to be,
"My Lord Duke,
"Your Grace's obedient servant,
"LYTTELTON.

"His Grace the Duke of Devonshire.
"&c. &c. &c."

APPENDIX II.

SECRETARY'S REPORT on the TEACHING of SCIENCE in certain PUBLIC and FIRST-GRADE SCHOOLS; together with APPENDED PAPERS.

CONTENTS.

Page.
INTRODUCTION - - - - - - 14

§1. General arrangements of the Schools - - 16
2. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes - - - - 20
3. Hours per week given to science in the several Colleges and Schools - - - - - 21
4. Subjects taught to Junior and Senior Students 23
5. Text-books in use at the several Colleges and Schools - - - - - - 25
6. Weight assigned to Scientific Attainments in determining a boy's position in the School - 29
7. Methods of teaching as regards oral demonstration, book-work, and practical work - - *ib.*
8. Tests of progress - - - - - 31
9. Most effective form of lesson - - - 35
10. Alternative subjects. - - - - - 36
11. Chemical and Physical Laboratories - - *ib.*
12. Observatories - - - - - - 43
13. Museums and Botanic Gardens - - - 45
14. School Scientific Societies - - - 49
15. Workshops - - - - - - 53
16. Knowledge necessary before Science is taught - 54
17. Rewards or encouragements to successful Students of Science - - - - - *ib.*
18. Evidence afforded as to the effect of Science teaching upon the intellectual life of the School - - 55
19. Suggested improvements in the teaching of Science in Schools - - - - 56
20. On the expenses necessarily attendant upon Science teaching - - - - 57
21. Science Teachers - - - - - 58
22. On the Obstacles to Science teaching in Schools 59
23. How the Universities can best aid Science teaching - - - - - 60
24. How the Government can best aid Science teaching - - - - - *ib.*

Memorandum on the Modern Department - 61
Memorandum on Science Programmes - - 62

APPENDED STATEMENTS.

1. Various Papers by Messrs. Wilson, Tuckwell, Foster, and Hale, on Science Teaching - 63
2. Catalogue of Apparatus for the Teaching of Physics and of Inorganic Chemistry, with prices attached - - - - - - 77
3. Sketch of Experiments in Physics and in Inorganic Chemistry - - - - - - 85

INTRODUCTION.

MY LORD DUKE,

IN submitting to your Grace the Report on Science Teaching in Schools, which I have prepared in accordance with the instructions of the Commission, I beg leave, in the first place, to state the manner in which the information required has been obtained.

It will be within the recollection of the Commissioners that prior to the date on which I was instructed to make my inquiry, a letter had been sent to the Head Masters of certain of the Schools, asking them to furnish a statement showing to what extent Scientific Instruction had been introduced into them; how many pupils had availed themselves of it, and with what effect, in each year, since its introduction. Although a considerable amount of valuable information was received in reply to that circular letter, the amount of information was not at all constant for each School; and it struck me as quite possible that if I limited myself to a mere inspection of the Schools, without any common programme, the information that I should obtain by merely visiting the Schools might be as unequal as that furnished by the replies to the statement in question.

In order, therefore, to obviate this possible objection, I prepared a list of queries dealing with the questions which I imagined the Commissioners might consider to be of the greatest importance, having in view the letter from the Chairman of the Endowed Schools' Commission, dated the 25th of March 1871; and before acting upon those queries, I fortified my opinion by consulting Professor Huxley, one of Her Majesty's Commissioners, and Mr. Fitch, one of the Assistant Commissioners of the Endowed Schools' Commission. They were good enough, not only to approve my mode of action, but to add largely to the queries. It was ultimately decided that these queries should be sent to the Schools already named with a covering letter. I append a copy of the covering letter and of the queries.

"Aid to Science Commission,
6, Old Palace Yard, London, S.W.,
Sept. 27, 1872.

"SIR,

"I AM directed by the Duke of Devonshire, the Chairman of this Commission, to state that the Commissioners are extremely anxious to obtain the fullest information respecting Science teaching in the public and first-grade schools, and the Commissioners will, therefore, feel greatly obliged if, in addition to the information which you have already been good enough to furnish, you will kindly favour them by answering, as far as you may be able, the several questions in the accompanying Schedule.

"I am to add, that as the Commissioners are desirous of obtaining information from schools differing in organisation, the questions in the accompanying Schedule are designed to cover the work of a good many schools. It is not, therefore, expected that answers will be given to any questions but those which may happen to apply to your school.

"I am further to say that I have been requested by His Grace to confer with you personally, to explain the precise objects the Commissioners have in view, and the kind of information which will be most valuable to them, if you consider such a course desirable; in which case I shall be obliged if you will inform me on what day it will be most convenient to you that I should visit your school.

"I have the honour to be, Sir,
"Your obedient servant,
"J. NORMAN LOCKYER,
"Secretary."

"SCHEDULE of PARTICULARS on which Information is desired by the Royal Commission on Scientific Instruction and the Advancement of Science.

"Name of School or College, ____________________

"*General Arrangements.*

"I. How is the school classified?

"II. Is Science a necessary part of the school course, or is it taught only in special forms or departments?

"III. Copy of time table.

"IV. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

"V. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes.

"VI. Amount of knowledge required before the study of Science is commenced.

"VII. Is any alternative or choice of subjects offered?

"What departments of Science are preferred?

"(*a*) By parents?
"(*b*) By the boys?

"VIII. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?

"IX. What weight is assigned to scientific attainments in determining a boy's position in the school?

"*Methods of Teaching.*

"X. What proportions of the lessons take the form respectively of—

"(*a*) Oral teaching and demonstration?
"(*b*) Book work?
"(*c*) Practical work?

"XI. Which form of lesson is found to be most effective?

"XII. How are text-books used? *e.g.*, is book-work supplementary or preparatory to the oral lesson?

"XIII. Is the use of note-books encouraged (*a*) during or (*b*) after the lesson, and to what extent?

"XIV. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

"XV. Describe any method of teaching some special branch of Science which has been found successful in your school.

"*Instruments of Teaching.*

"XVI. What special provision (*e.g.*, laboratory, lecture-room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

"(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

"XVII. Number of assistants and curators, and annual cost.

"XVIII. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

"XIX. Is there a workshop? and if so, how, and for what particular purpose is it used?

"XX. What text-books are in use? distinguishing between those for the junior and senior classes?

"XXI. To what books of reference, other than ordinary school books, have the scholars access?

"XXII. Is there any Scientific Society or Club in connexion with the School? and if so, who compose it, how is it worked, and what is its influence on the boys?

Tests of Progress.

XXIII. How often is the work tested?

"XXIV. In what way? *e.g.*, by examination o note-books, or by oral or written questions?

"XXV. By whom? by the teachers of the subjects, or by an independent examiner?

Teachers.

"XXVI. Is there any difficulty in procuring competent Science Masters?

"XXVII. Where are the best obtained? have they been specially trained for the work; and, if so, in what does such training consist?

"XXVIII. What evidence of scientific qualification tendered by candidates is found to be of most value?

"XXIX. Can you state any results of Science teaching in the school? Such as:

"(*a*.) Success, professional or otherwise, of individual scholars?
"(*b*.) Influence upon the general studies and intellectual life of the school?

"XXX. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful Students of Science in the School?

"XXXI. What improvements, do you think, could be effected in the teaching of Science in your own School?

"XXXII. What are the principal obstacles to the teaching of Science in your own School?

"XXXIII. How could the Universities best assist Science teaching in Schools?

"XXXIV. Can you suggest any way in which Government could assist Science teaching in Schools, as, for example, by inspection?

"XXXV. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

____
"Head Master."

"Date____________________."

In many cases the answers were not given until I had visited the school personally and stated verbally to the Head Master and the Science Master, in greater detail than was possible in the queries, the precise information required by the Commissioners and the object for which that information was sought.

In the various sections which follow, I have brought together, for the convenience of the Commissioners, the information thus obtained, that is, obtained both by inspection and by the printed replies to the questions. I have introduced my own opinions as little as possible, and I make no claim for originality in the Report: my only effort has been to place the available information before the Commission in the most authentic and convenient form. I have, however, referred at greater length to some of the points raised, and in order to strengthen the views which I have expressed, I have added, as Appendices to the Report, certain documents which support them.

J. NORMAN LOCKYER.

§ 1.—ON THE GENERAL ARRANGEMENTS OF THE SCHOOLS.

It is important, for a clear understanding of what follows, to give, at the outset, an idea of the organization adopted for teaching purposes in the various schools. This is not only necessary in order to analyse exactly the various time tables, and to determine the exact place of science in the curriculum, but I think it will be interesting to the Commissioners to see the various groupings adopted: it may be, also, that some light may thus be thrown on the question of "Modern Schools."

The schools may be arranged in the following groups:

I. Schools with only one main line, and that *classical*.
II. Schools with only one main line, in which *general fitness* determines place.
III. Schools with a Modern Side.
IV. Other schools.

I.—Schools with only one Main Line, and that Classical.

Eton College.

The nominal Forms are the VIth (the highest), the Vth, the Remove, the IVth, and the IIIrd; but these Forms are, in some cases, very large, *e.g.* the Vth contains about 480 boys. The VIth and Vth Forms together are, therefore, split up into 14 divisions, each under a different classical master. These divisions are arranged in groups, called A. B. C. D.

The A. group comprises divisions	1, 2, 3.
B. " "	4, 5, 6.
C. " "	7, 8, 9, 10.
D. " "	11, 12, 13, 14.

For mathematics and science (and in some cases for French), the different groups are divided afresh, on a different principle, among the mathematical staff (or the French staff). A whole group, *e.g.* B. or C., goes to mathematics together, and the mathematical masters arrange them, according to their mathematical proficiency, in different classes: ten mathematical classes can go on simultaneously.

A similar redistribution, but not so complete, is made for science-teaching.

The Remove and IVth form are similarly arranged, but they have no science-teaching.

Science is a necessary part of the school course from division 4 to 9 inclusive.

It is an alternative subject with Modern Languages, Modern History, Extra Classics, or Extra Mathematics, in divisions 1, 2, 3.

Rugby School.

At Rugby, the whole school is divided into—

Sixth Form and Upper School.
Middle School.
Lower School.

This is a *classical* division, and a boy's position in the school, therefore, depends upon classics.

Each of these main divisions has its own separate classification into sets for Mathematics, Modern Languages, and Natural Science, except the lower school, in which Natural Science is not taught.

There are three Natural Science sets in the 6th Form and Upper School, and seven in the Middle School.

Natural Science forms a necessary part of the course in the Middle School; in the Sixth Form and Upper School, the choice is allowed between Science and German.

St. Peter's College, Westminster.

At Westminster the school is classified, according to the attainments of the boys in classical and general learning, into the following forms:

	Boys.
VIth Form	20
Shell	25
Vth Form, Upper	25
Under	25
Remove	25
IVth Form, Upper	23
Under	25
Under School	20
	188

For mathematics it is again classed into six divisions, according to proficiency in that study; for French or German into groups of about 50 boys each, subdivided afresh into four or three classes according to proficiency; and for natural science the boys of the three highest divisions of the school, about 70 in number, and some 30 of the lower forms have been taken and classified afresh.

Science is necessary, under the new regulations, for all boys old enough to profit by it and capable of following the teaching. There is a power of exemption in special cases vested in the Head Master, who must report all such exemptions annually to the Governing Body.

Charterhouse School.

At Charterhouse we find—

6th	Upper school.
Upper 5th	
Under 5th	
Upper 4th	Under school.
Under 4th	
Upper Shell	
Under Shell	
Upper 3rd	
Under 3rd	
2nd	
1st	

Science forms a part of the obligatory school course from the sixth form to the under third inclusive.

II.—Schools with only one Main Line, in which general fitness determines place.

City of London School.

The general arrangements of the City of London School are as follows:—

The school is divided for general purposes into Forms and Classes, and these are grouped into divisions for Science purposes.

6th form	1st division.
5th ditto	
4th class	2nd division.
Latin class	
3rd class	3rd division.
2nd class	
1st class	4th division.
Grammar class	
1st junior class	5th division.
2nd junior class	
3rd junior class	6th division.
4th junior class	

Science is a necessary part of the school course.

Dulwich College.

The school is divided into three Sections (the Junior Section, the Senior Section, and the Sixth Form), within each of which an independent classification is made for each subject or group of subjects in which instruction is given.

Under this System all boys alike receive instruction in those subjects which are regarded as essential to a liberal education, while the opportunity is given of studying, under a distinct classification, such additional special subjects as may be thought desirable, in each case, with a view to the boy's intended profession or pursuit. Every boy is classed in each subject in which he receives instruction strictly in accordance with his actual proficiency in that subject.

The subjects of instruction are grouped as follows:—

In the Junior Section—

1. Form work, including English, Latin, and French.
2. Arithmetic.
3. Drawing.

In the Senior Section and Sixth Form—

1. Form work, including English, Latin, and French.
2. Mathematics.
3. Greek.
4. German.
5. Physical science.
6. Drawing.

Instruction in Science is open to all boys in the Senior Section and in the Sixth Form, but is not compulsory, except so far that all boys not learning Greek and the higher Classics are required to take up either Physics or Geology. The Chemistry Classes are held at such times as to be open to all boys in the Sixth Form and the Senior Section of the School, whether they belong to the classes for Physics or Geology, or not.

University College School.

A boy's general standing in this school is defined by Forms; the "Form" or mean position of each boy is determined by calculating the average rank of all his classes.

The work is done in "Classes," which rank from Upper Sixth, Sixth, and Lower Sixth, to Upper First, First, and Lower First.

Boys are examined at entry and classified, with a view to their requirements, *in each subject* separately according to individual proficiency. Thus, the same boy may be in a high class in one subject and in a low one in another.

Each boy, in fact, has his own programme of work, which is not necessarily identical with that of any other boy.

The revision of all classes, and, therefore, of form position, by promotion or degradation at the end of the session is universal. Each step, however, must be earned, that is, a boy must satisfy his master that he can and will follow the work of the rank of the class to which he is advanced.

Individual cases of promotion and degradation are of almost daily occurrence throughout the year, except during the last month of each term, but this is the only limitation to the practice of *ab libitum* revision.

Under this system it is claimed that a boy is not, as in many public schools, kept for a long time in any class which is either too high or too low for him, but may, at any time, be removed from a class which experience has shown is not suitable for him to one adapted as closely as possible to his actual requirements. In this way the opposite evils of disheartening a boy or of making him careless are equally avoided, and his interest in every part of his work is constantly maintained.

Taunton College School.

In Taunton College School we have also an example of a school arranged into upper, middle, and lower (each compartment being subdivided), the principle of classification being uniform, that is, each boy is placed according to his general fitness, and his marks, in all the subjects taught, including, of course, Science, determine his position in his form; further, there is no different arrangement of classes for different subjects.

Science is necessary for all boys in the Upper and Middle Schools.

III.—Schools with a Modern Side.

At Harrow, Clifton, Marlborough, Wellington, Cheltenham, Rossall, and Christ's Hospital, we find a well-defined and so styled "Modern Side."

But in the manner in which this Modern Side is regulated we find wide differences.

An important distinction may be drawn between those schools in which a boy, by studying the modern subjects, can rise to the 6th Form, or *a* 6th Form, and those in which he cannot.

Harrow School.

At Harrow the school consists of two sides: (1.) The Classical side; and the Modern Side, established in September 1869. The Forms are as follows:

Classical Side.

The Monitors and VI. 1		35 boys.
VI. 2		31 ,,
First Vth		35 ,,
Second Vth		32 ,,
Third V.		33 ,,
Upper Remove		33 ,,
Lower Remove	α 34	63 ,,
,, ,,	β 29	
Upper Shell	α 32	65 ,,
,, ,,	β 33	
Middle Shell	α 32	63 ,,
,, ,,	β 31	
Lower Shell		33 ,,
First IVth		33 ,,
Second IV.		32 ,,
Third IV.		17 ,,

Modern Side.

VIth	6 boys.
Upper Vth	9 ,,
Lower Vth	12 ,,
Modern Remove	10 ,,
Upper Shell	11 ,,
Lower Shell	4 ,,

Science is taught to all boys on the Modern Side, and to boys in the Vth Forms and Upper Remove on the Classical Side.

Wellington College.

At Wellington College, we have two schools side by side, as shown in the accompanying scheme, the "Classical School," and the "Mathematical" or "Modern School." These are quite parallel and equal in position and status. The Mathematical School contains rather more than one-third of the whole school, or nearly two-fifths, excluding in the Lower School.

Classical School.	*Mathematical or Modern School.*
Sixth Form.	Sixth Form.
Upper School.	Upper School.
Middle School.	Middle School.
Lower School.	

It will be observed that there is a sixth form on each side, and the Prefects of the schools may be indifferently in each school. Boys are not allowed to enter the Modern School unless they are distinctly qualified to do so. The masters are judges as to this. Boys may be transferred from one school to the other at any point of either school; and this, I am assured by the Head Master, is frequently done, so that there is, so to speak, a complete intermixture of the two divisions. Those whose classical work is important to their future (or who will, *e.g.*, make classics serviceable in examinations, as at Woolwich), but wish to end their work at school with a mathematical training, frequently enter the Mathematical School from the sixth or fifth. Conversely, good scholars in the Modern School have some classical lessons with the classical sixth.

For modern languages, mathematics, and science, the forms are rearranged into sets as under:—

Classical.

Sixth into	2 mathematical	sets.
	2 German	,,
	1 science	,,
Upper School into (3 forms)	4 mathematical	,,
	4 modern language	,,
Middle School into (4 forms)	5 mathematical	,,
	5 modern language	,,

Mathematical or Modern.

Sixth and Upper School into (3 forms)	4 mathematical	sets.
	3 science	,,
	1 Greek	,,
Middle School (3 forms)	3 mathematical	,,

[Modern languages being the basis of form division, but promotions made by all subjects conjointly.]

Lower School into (2 small forms)	3 mathematical	sets.
	2 modern language	,,

Science is necessary on the Classical Side in the sixth (unless Drawing be preferred); on the Modern Side in all forms but the lowest (unless Greek be preferred). There is also a voluntary class in Practical Chemistry.

Rossall School.

At Rossall, also, we find a Modern School side by side with a Classical one, and almost, if not quite, on an equal footing with it, a severe competition existing between the schools in the results of the teaching of the subjects common to both, the same subject being dealt with by different teachers. The difference between the two schools consists in replacing Greek and drawing in the Classical school by higher Mathematics, English, Chemistry, and Book-keeping in the Modern one.

The divisions in these schools are as follow :—

Classical.		*Modern.*
Monitors	Upper. Lower.	
Probationers	Upper. Lower.	
V. Form	Upper Lower	A Upper.
IV. Form		A Lower.
III. Form		B Upper.
II. Form		B Lower.
I. Form	Upper. Lower.	
Lower School	Upper Remove. Lower Remove.	

Science is a necessary part of the school course in the Modern Department, but is open to volunteers from the Classical Side.

Winchester College.

At Winchester College the main division is into four Blocks, called—

(A.) Sixth Book of 60 (in round numbers).
(B.) Senior Part V. of 110 „ „
(C.) Middle Part V. of 150 „ „
(D.) Junior Part V. of 60 „ „

Besides these there is a Modern Class, ranking with B.

There have been for some time one or two Prefects at a time, belonging to the Modern Class, some of whom have taken part with the other Sixth Book boys in their lessons in the subjects which they did in common.

The blocks are subdivided for the several subjects of study, as follows, into the following number of classes :—

—	Classics.	Mathematics.	Science.	Modern Languages.
Block A into -	2	6	1	3
B -	4	7	4	4
C -	5	10	—	6
D -	2	4	—	2

Science is taught to boys in the Upper Sixth Book who have evinced special capacity for it, or who desire it themselves, or whose parents wish it, and to all boys in the Lower Sixth Book, in Senior Part V., and in the Modern Class.

King's College School.

The school is classified into—

A. Classical Department.
B. Modern Department.
C. Preparatory or Lower School.

The following is the distribution of the classes :—

Classical Side.	*Modern Side.*
Upper Sixth.	* Upper Sixth.
Lower Sixth.	* Lower Sixth.
Upper Fifth.	* Upper Fifth.
* Senior Matriculation Class.	* Middle Fifth.
* Junior Matriculation Class.	
Lower Fifth.	* Lower Fifth.
* Fourth.	* Upper Fourth.
	* Lower Fourth.
* Remove.	* Upper Remove.
	* Lower Remove.

Science Class.

Commercial Class.

Lower School.

* Third.
Upper Second.
Lower Second.
* Upper First.
Middle First.†
Lower First.

The classes marked * attend lectures on science and take up class books on science.

Science is a necessary part of the school course—

(1.) In the matriculation, fourth, and remove classes of the classical division.
(2.) In the whole of the Modern Department, excepting the commercial and special classes.
(3.) In the Third and Upper First classes of the lower school.
    (*a.*) The Elementary Physical Class is attended by the Fourth and Remove (A), the Upper and Lower Fourth, Upper and Lower Remove (B), the Third and Upper First (C).
    (*b.*) The Chemical Class is attended by the Matriculation Class (A), and Upper and Middle Mathematical Classes (B), and by a few boys who join for the Practical Chemistry.
    (*c.*) The Advanced Physical Class is attended by the First, Fifth, Upper and Lower Fourth Matriculation Classes (B).

Clifton College.

At Clifton, also, there is a well-developed Modern Side, the divisions of which are arranged according to proficiency in Science :—

Classical (229 Boys).		*Modern* (110 Boys).
Sixth Form.		
Fifth Form.	First Division.	First Division.
	Second Division.	
Fourth Form. and Third Form.	First Division.	Second Division.
	Second Division.	
	Third Division.	Third Division.
	Fourth Division.	Fourth Division.
Junior School—114 Boys—		Junior School.

Science is taught as an alternative for German in the Sixth and Fifth, that is, the four highest forms of the Classical Side. In the remaining forms of the Classical side, and throughout the Modern Side, as also in the two highest forms of the Junior School, it is taught as a matter of course to all boys without exception. In the lowest three forms of the Junior School, consisting of boys between 10 and 12 years of age, Science is not taught. In the Sixth and Fifth forms, both Classical and Modern, boys who show special taste for Science, or who are likely to require it for professional purposes, or for some competitive examination, are also taught in special classes so arranged as to form alternatives for some other parts of the school routine. There are also voluntary classes doing practical work in the Chemical Laboratory, Botany, Geology, Physical Geography, Zoology, and Physiology.

It is specially to be remarked that the divisions of the Upper Forms on the *Classical Side* represent proficiency in *Science*.

This curious fact, perhaps, arises from the other one in this school. There are special Science Classes for the Sixth and Fifth Forms, besides Voluntary Classes open to the whole school; which, in the case of Chemistry, are taken more advantage of by the Classical boys than by those on the Modern Side. An idea of the arrangement of these Voluntary Classes may be gathered from the following extract from the Report :—

> " (*e.*) Voluntary Classes :
>
> " (1.) Boys working in the chemical laboratory are obliged to attend not less than three hours every week; many go much more than that. The hours of laboratory work are generally taken from what in our terminology is called 'out-of-school hours,' designated in the question as playtime.
>
> " (2.) The remaining voluntary classes mentioned under question 2 generally meet once a week. In the case of Botany and Geology, the lessons are supplemented by excursions from time to time on half-holidays. In all the various classes the boys are expected to keep note-books, and to give some time to the study out of school, either as preparation for the lesson or in the way of reading afterwards. It should also be added, that of Voluntary Botany, Geology, and Physical Geography Classes, it seldom happens that more than *two* are going on during the same term; that the Zoology and Physiology Classes are confined to a small number of the senior boys; and that none of these voluntary classes involve any extra payment excepting the work in the chemical laboratory."

---

† *Note.*—"Since the date of the Report, King's College School," the Head Master states, "has considerably increased, the nomenclature of " the Classes has been altered, a Middle School has been added, the " teaching of Science has been still further extended, and additional " Science Prizes have been introduced." October 22, 1873.

Marlborough College.

The arrangements at Marlborough are as follows:—

There are three divisions of the school, the Upper, the Lower, and the Modern School. The lower school contains all those junior boys whose attainments do not enable them to win a place in the upper school. The modern school is mainly composed of boys intended for the army and navy, for Woolwich, for the Engineering College, for the Indian Civil Service, and for business.

These are arranged as follows:—

Classical.	*Modern.*
Sixth.	
Upper Fifth.	
Middle and Lower Fifth.	Upper Division.
Upper Shell.	Middle Division A.
Upper Fourth.	Middle Division B.
Middle and Lower Fourth.	Lower Division.

Lower School.

Upper Third.
Lower Shell.
Lower Third.
Upper Second.

There are two voluntary Science forms from the Classical Side, consisting of boys from the Middle and two Lower Fifths, and from the Upper Shell and the two Upper Fourths.

Two hours a week of science work forms a necessary part of the school work of the upper and two middle divisions of the modern school (about 80 boys); and one hour a week is necessary in the case of the upper shell, upper fourth A., and upper fourth B. (about 75 boys in all). Otherwise, certain forms are grouped together for science purposes: thus, about 10 boys from each of the three fifths (lower fifth A and B, and middle fifth), with five from the upper fifth, and four from the sixth form for the upper voluntary science form of 43 boys. Again, about 10 boys from each of the upper shell, upper fourth A form, and upper fourth B form, form the lower voluntary science form of 31 boys. Each of those forms are voluntary; there are three alternative subjects.

Cheltenham College.

At Cheltenham College there are three departments, viz., the classical, the military and civil, and the junior (boys under 13 years of age).

In the Classical Department science is taught as an alternative with German to boys in the four highest of the nine classes; and to select boys in first class a second scientific subject is also taught as alternative with French. Boys in the Latin class (no Greek) also are taught science. Total number learning science, 86.

In the Military and Civil Department, science is a necessary part of the school course for all boys in the four highest of the nine classes. Total number learning science, 128.

There is perfect equality between the Classical and Military Departments. The Prefects are taken from each Department equally, *i.e.*, every boy in any division of the first or highest class of either department becomes a Prefect at 17 years of age, or at 16, if he is in the highest division of the First Class of either Department. Marks are given for work in sciences as for other work; and Promotion is made on the total of marks including marks for science.

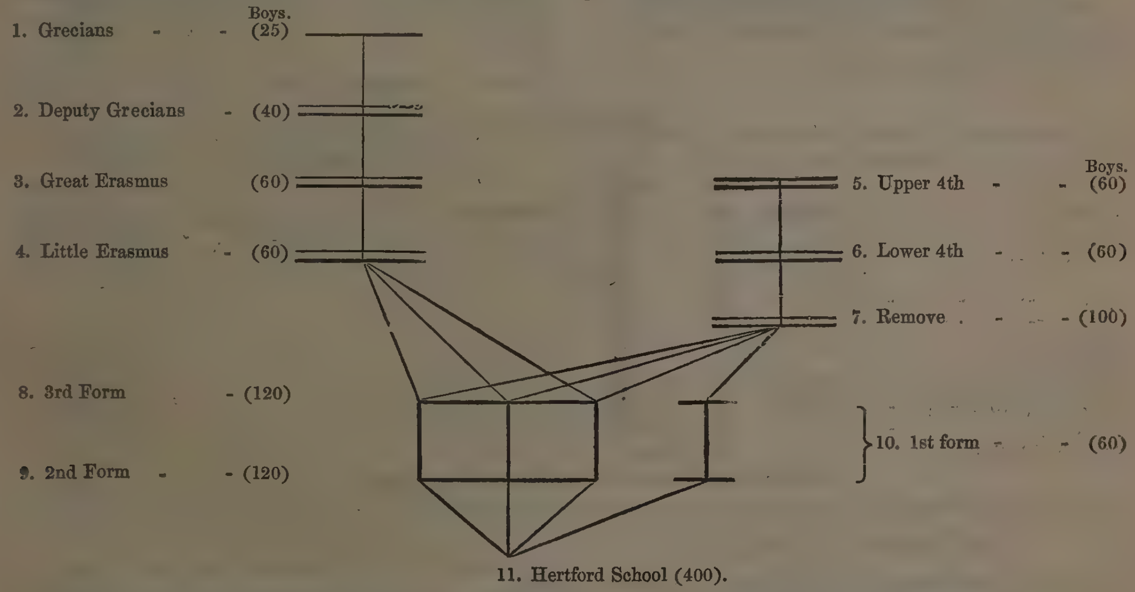
There is a Natural History Society with evening meetings in winter, and excursions (chiefly botanical) in summer.

Christ's Hospital.

The classification adopted at Christ's Hospital is somewhat peculiar.

In the "Grammar School" or language department, every boy (with the exception of the 50 Naval Boys) passes at least half his school hours; besides this, there are the Mathematical and Commercial Schools and a Naval School.

The accompanying diagram will show the arrangement adopted in the Grammar School, and it will be seen that part of it is, in effect, a Modern School.



The horizontal lines denote the several classes. The classes 8, 9, are under three parallel masters. 10 is composed of backward boys, who are older than the average age on coming from Hertford.

Boys pass from 8, 9, into 1–4 as soon as they are fit, but boys who reach the age of 13½ before they are qualified for 4, are draughted from 8, 9, into 7, as are also all boys from 10 on reaching the age of 13½.

The classes 1–4 are intended to fit boys for professional life, 5–7 for commercial life.

Classes 1, 2, spend 9 hours a week, and 3, 5, an average of 6½ hours in the Mathematical School.

Classes 3, 5, give an average of 5 hours a week, and 4–10 half their school hours, minus a short time given to drawing, in the Commercial School (for arithmetic, writing, reading, geography, &c.).

In the Naval School some 50 boys are prepared for sea.

Science is a necessary part of the school course for Classes 1, 2, 3, and 5, and very elementary lessons in Natural Philosophy are given to the boys of Class 10, with the view of stimulating their powers of observation.

IV.—OTHER SCHOOLS.

Manchester Grammar School.

The arrangements adopted at the Manchester Grammar School will be gathered from the following scheme, in which the Forms are numbered from the 6th downwards:—

FORMS.

Classical.	Science.	Mathematics.	Modern Languages.
6th	6th	6th	
Transitus	Transitus		
Upper 5th			
Lower 5th	5th		
" 4th			
Remove	Remove		Remove
" 4th			French 3rd
" 3rd			" 2nd
" 2nd			" U.
Upper 1st			" M.
Lower 1st			" L.

For the purpose of mathematical teaching all the forms below the Three Sixths, Science, Classical, and Mathematical are re-distributed into three groups, each consisting of five sets.

In the Science and Mathematical forms the boy has his choice between the study of classics and modern languages.

In addition to constituting the principal part of the teaching of the four Science forms, Science is an essential part of the teaching of the Mathematical Sixth. There are, besides, optional classes for the teaching of Mechanics, Elementary Chemistry, and Physical Geography, drawn from all parts of the school.

---

§ 2.—SUMMARY OF THE NUMBER AND AVERAGE AGE OF BOYS LEARNING EACH OF THE VARIOUS SUBJECTS IN THE NATURAL SCIENCE CLASSES.

ETON COLLEGE.

	Optics.	Chemistry.	Hydrostatics.
Number of boys -	5	64	22
Average age - -	17–18	15–18	16

[The above refers to Mr. Madan's present classes.]

Divisions I.—III. - -	3 classes in Chemistry. 1 class in Physical Geography.
IVth division, Chemistry.	
Divisions V.—XIV. formed until last schooltime - -	6 classes in Physical Geography. 3 classes in Astronomy. 3 classes in Mechanics and Hydrostatics. 1 class in Heat.

Last schooltime.

Divisions V.—VIII. formed -	2 classes in Physical Geography. 3 classes in Mechanics.

Divisions IX.—XIV. had no Physical Science.

Other boys are learning physical geography, or elementary astronomy, or mechanics, in the Science hours. See Mr. Dalton's answer.

Their ages range from 18 to 13.

HARROW SCHOOL.

At Harrow the boys on the Modern Side have been taught in two divisions, each consisting of about 26. In future they will be divided into three divisions. The boys on the Classical Side are at present taught in four divisions, each consisting of about 32 boys.

RUGBY SCHOOL.

At Rugby School the number of boys and average age in each set are given below :—

Sixth Form and Upper School.

—	Number of Boys.	Average Age.
1st set, Heat and Optics - -	22	$17\frac{7}{12}$
2nd set, Electricity - -	17	$16\frac{11}{12}$
3rd set, Chemistry - - -	50	$16\frac{3}{4}$

Middle School.

4th set, 1st Physics - -	20	$16\frac{11}{12}$
5th set, 2nd Physics - -	51	$16\frac{1}{3}$
6th set, 1st Geology - -	34	$16\frac{1}{6}$
7th set, 2nd Geology - -	24	$16\frac{1}{12}$
8th set, 1st Botany - - -	22	$15\frac{1}{6}$
9th set, 2nd - - -	34	$14\frac{3}{4}$
10th set, 3rd - - -	30	$15\frac{5}{12}$

CLIFTON COLLEGE.

Classical Side.

		Boys.	Average age.
VI. and V. - -	1st division	19	16
„ - -	2d „	12	16
IV. and III - -	1st „	24	$14\frac{1}{2}$
„ - - -	2d „	43	$14\frac{1}{2}$
„ - - -	3rd „	33	14
„ - - -	4th „	30	13
Zoology - - -	average No.	4	17
Physiology - -	„	4	17
Chemical laboratory -	two divisions	40	18 to 16
Botany class (voluntary) -	average No.	12	15 to 16
Geology „ „ -	„	11	15 to 16
Physical Geography -	„	10	15 to 16

Modern Side.

			Average age.
Modern Side - -	1st division	31	16
„ - -	2d „	36	$15\frac{1}{2}$
„ - -	3d „	43	$14\frac{1}{2}$

Junior School, one division, 54 boys, average age, 12.

MARLBOROUGH COLLEGE.

At Marlborough College, the age of those boys who study science varies between 13 and 19, the average age being, perhaps, 16. The actual number of boys who do science is at this time 202; of these 47 do only one subject a week (1 hour chemistry); 155 do two subjects a week (1 hour chemistry, and 1 hour electricity), while the Woolwich class, numbering 17, do three subjects a week.

WINCHESTER COLLEGE.

1. Mechanics and hydrostatics, sixth book. No., 12. Age, 17.
2. Geology. No., 30. Age, 17.
3. } Physical geography. { No., 40. Age, 16.
4. } Physical geography. { No., 40. Age, 16.

ST. PETER'S COLLEGE, WESTMINSTER.

62 Natural Science—Hydrostatics, A. 3 classes—average age, seniors, 17; juniors, 16 or less.

27 Natural Science—Physical Geography, B. 2 classes—average ages 16, 15, or less.

CHELTENHAM COLLEGE.

In the Classical Department:—

		Boys.	Average age.
Class I.	Electricity	6	18 years 1 months.
	Chemistry	6	17 „ 0 „
	Botany	20	17 „ 8 „
„ II	Chemistry	18	16 „ 9 „
„ III.	Botany	8	16 „ 6 „
„ IV.	Chemistry	12	17 „ 6 „
Latin Class.	Chemistry	16	16 „ 2 „

In the Military Department:—

		Boys.	Average age.
Class I.	Chemistry Electricity	39	17 years 0 months.
„ II.	Geology - Light -	30	16 „ 2 „
„ III.	Heat -	29	16 „ 3 „
„ IV.	Elementary Physics -	29	16 „ 1 „

WELLINGTON COLLEGE.

Classical sixth (average age) -	17·057	
	yrs.	m.
Mathematical school, 1st and 2nd set, 24 boys, average age - - - - -	16	11
Mathematical school, 3rd set, 26 boys, average age	15	11
„ „ 4th „ (once a week only) „	15	4

CHARTERHOUSE SCHOOL.

	No. of boys.	Ages.	
6th Form -	12 -	17	Upper School,
Upper 5th „ -	12 -	16	
Under 5th „ -	20 -	16	
Upper 4th „ -	19 -	14	
Under 4th „ -	15 -	14	
Upper Shell -	14 -	13	
Under Shell -	15 -	13	
Upper 3rd -	18 -	12	
Under 3rd -	21 -	12	

CHRIST'S HOSPITAL.

			Age.
Range of age of	1. Grecians -	25 boys	- 16–19.
„	2. Deputy Grecians	40 „	- 14–16.
„	3, 5, -	- 120 „	- 14½–16.
„	4, 6, -	- 120 „	- 12½–14½.

CITY OF LONDON SCHOOL.

—		No. of boys.	Average age.
1st division	6th form - -	27	17
	5th „ - -	24	15¾
2nd division	4th class - -	36	15
	Latin class - -	50	14¾
3rd division	3rd class - -	61	14½
	2nd class - -	64	13⅔
4th division	1st class - -	85	13⅝
	Grammar class - -	97	13½
5th division	1st junior class - -	70	13 nearly.
	2nd junior class - -	57	12⅔
6th division	3rd junior class - -	49	10¾
	4th junior class - -	47	10⅙

TAUNTON COLLEGE SCHOOL.

Advanced chemistry, 20 boys of about 16 years old.
Botany, do. do.
Elementary chemistry, 50 boys of about 14 years old.
Mechanics, do. do.

KING'S COLLEGE SCHOOL.

(1.) Advanced class of natural philosophy. Number of boys, 35. Average age, 16.
(2.) Chemistry class. No. of boys, 54. Average age just under 16.
(3.) Elementary class in physics. No. of boys, 160. Average age slightly under 15.

MANCHESTER GRAMMAR SCHOOL.

	No. of boys.	Average age.
Mathematical Sixth - -	15	17½
Science Sixth - - -	20	16½
Science Transitus - -	30	15½
Science Fifth - - -	30	15
Science Remove - -	40	14

DULWICH COLLEGE.

		Average age.
Chemistry, 1st class - -	24 boys.	15½
„ 2nd class - -	28 „	13¾
Practical chemistry, 1st class -	34 „	15½
„ 2nd class -	18 „	13½
Electricity and magnetism -	62 „	14¼
Geology - - -	24 „	14⅓
Physical Geography - -	13 „	14¾

The Master of Dulwich College remarks, with regard to this return :—" I have stated the actual average age, but the " return in this respect is illusory, since the recent increase " of the school (from 130 to 500 boys), and the excess, in " consequence of young boys lately admitted, reduces the " average of age below its normal amount."

UNIVERSITY COLLEGE SCHOOL.

Michaelmas Term, 1872.

	No. of boys.	Average age Years.	Months.
Upper Sixth; Applied Mathematics -	10	16	1
Upper Sixth; Chemistry, theoretical and practical - - -	18	15	11
Sixth; Natural Philosophy - -	47	15	6
Upper Fifth; Chemistry and Chemical Physics - - - -	57	15	3
Fifth; Chemistry - - -	30	15	4
Fifth; Astronomy - - -	21	15	2

(The average age is computed from the *beginning* of the Sessional Course.)

§ 3.—HOURS PER WEEK GIVEN TO SCIENCE IN THE SEVERAL COLLEGES AND SCHOOLS.

College or School.	Class Work in School Hours.	Practical Work.	Preparation.
ETON COLLEGE -	*A. Divisions,* four hours to Alternative Subjects, Science, History, &c., &c. *B. Divisions,* two hours to Science. *C. Divisions,* the same as *B.*, except that there is also a Geography lesson.	There is voluntary work in the laboratory during play hours.	Exercises are done out of school.
RUGBY SCHOOL -	Two lessons in each subject of one hour's duration each.	Actual dissection of specimens by each boy is a regular part of each botanical lesson. In the chemical laboratory all the work is practical.	The amount and kind of preparation required differs in different "sets."
CLIFTON COLLEGE -	*Classical Side:* VI. & V., also the upper and lower IV. and III.: each division *two lectures* every week. *Modern Side:* first, second, third, and fourth Divisions: each division *four lectures* every week. *Junior School:* in one division, *one lecture* every week. *Special Science Classes,* consisting of boys in the VI. and V. forms, seven or eight hours every week in addition to the lectures mentioned above.	Boys working in the chemical laboratory are obliged to attend three hours every week, generally taken from "out-of-school hours." A few boys do some work in the small physical laboratory with the physical master.	In all the various classes the boys are expected to keep note-books, and to give some time to the study out of school, either as preparation for the lesson, or in the way of reading afterwards.
MARLBOROUGH COLLEGE.	*Modern school, middle division A.,* one hour to chemistry and one hour to electricity; middle division B., two hours to chemistry. *Upper Shell Form,* one hour to chemistry. *Lower Voluntary Form,* consisting of about 10 boys from the Upper Shell, and from each of the two upper fourths (A. & B.), one hour to electricity.		

Hours per Week given to Science in the several Colleges and Schools—*continued.*

College or School.	Class Work in School Hours.	Practical Work.	Preparation.
MARLBOROUGH COLLEGE —*cont.*	*Upper Division* (*Modern School*) one hour to chemistry, and one hour to electricity. *Upper Fourth* A., and *Upper Fourth* B., one hour to chemistry. *Upper Voluntary Form*, chiefly from the middle and two lower fifths, one hour to electricity, and one hour to chemistry. *Woolwich Class, one hour to Heat.*		
WINCHESTER COLLEGE.	*Sixth Book and Senior Part V.*, two hours to Natural Science. *Modern Class,* two hours.	- - -	The work for science out of school consists of this: — Note-books are kept by the boys, and looked over carefully by the Master once a week; and the boys have some book (in most subjects), also, which they are requested to study out of school.
ST. PETER'S COLLEGE, WESTMINSTER.	*Senior class*, two hours; *Junior class*, one hour.	- - -	At least two hours a day of additional work in preparation is given by industrious boys, and one hour enforced from all.
CHELTENHAM COLLEGE.	*Classical Department, Class I.* A. B. Two hours and a quarter to botany, and the same to chemistry; one hour and three quarters to electricity. *Class II.* A.: One hour and three-quarters to chemistry. *Class II.* B.: One hour to chemistry. *Class III.*: One hour and three-quarters to botany; one hour and three-quarters to chemistry. *Military and Civil Department, Class I.* A.: Four hours and three-quarters to Natural Science. *Class I.* B., and *Class I.* C.: Two hours to Natural Science. *Class II.* A.: Two hours to Natural Science. *Class II.* B.: One hour and three-quarters to Natural Science. *Class III.* A., and *Class III.* B.: One hour and three-quarters to Natural Science. *Class IV.* A. and B.: Two hours and a quarter to Natural Science.	Seven hours to chemistry. Six boys in the classical department are taken, two at a time, three evenings weekly, two hours each time. In Botany, great stress is laid on actual dissection and classification. *Military Department.* About half the time with the highest classes is given to practical work. With the lower classes, about half the time is given, when the subject allows, to experimental demonstration.	In all departments of the college much time is given out of school hours to preparation of work of every kind. All boys are in school 28 hours a week. Hard working boys in the upper classes would give 25 to 30 hours a week to preparation out of school. The idlest boarder in the lowest class must give 13 hours a week, in the evenings, to preparation under supervision in large room. Elder boys work in their own study without supervision.
WELLINGTON COLLEGE.	*Classical Sixth*: One hour to science, or two hours by those who do not learn drawing. *Mathematical Sixth*: Three hours to science (or Greek). *Upper School*, three hours (or Greek). *Middle School* (two of the three forms), one hour.	About two-thirds of the first division two hours to Electrical Measurements (the subject at present), for five or six consecutive weeks in the year: four boys are taken together. In the voluntary chemical class, 10 boys in two sets. Each set works one hour and a half in the laboratory.	In *Modern School*, two hours to the reproduction of lectures, or the working of examples. In *Classical School*, one hour to the same.
ROSSALL SCHOOL -	- - - - - -	Five or six boys work at practical chemistry in the laboratory, two hours and half.	No time is devoted to preparation out of school.
CHARTERHOUSE SCHOOL.	Two hours.		
CHRIST'S HOSPITAL -	*Classical School, Class* III., *Upper Half*: two hours to chemistry; *Class* III., *Lower Half*, one hour to Natural Philosophy. *Modern School, Class* V., *Upper Half*: Two hours to chemistry; *Lower Half*: one hour to Natural Philosophy. The time given to Natural Science is outside the regular school hours: as a matter of fact, every boy in the senior part of the school has to give one or two hours a week more than the general school hours to some subject or other. All junior boys have about 26 hours a week in school; all senior boys from 27 to 29 hours.	Sometimes replaces class work. See Prof. Russell's Report, in APPENDIX VI.	
CITY OF LONDON SCHOOL.	*First, second, third and fourth divisions,* a lecture, of an hour's duration, once a week. *Fifth and sixth divisions,* a lecture, lasting an hour and a quarter, once a week. An occasional lesson, of one hour's duration, is given in the Lower School.	Practical chemistry, two hours. The half holiday is utilised for the practical work.	A few boys in each division avail themselves of the half hours (12 to 12.30 and 3 to 3.30), for trying some of the experiments shown at the lectures. Boys are also helped (during play time) to prepare for the various science examinations at South Kensington, &c. The science exercises have to be prepared some time during the week.

Hours per Week given to Science in the several Colleges and Schools—*continued.*

College or School.	Class Work in School Hours.	Practical Work.	Preparation.
TAUNTON COLLEGE SCHOOL	In the Upper School, three hours to chemistry, and two hours to botany. In the Middle School, two hours to chemistry, and two hours to mechanics.	Two thirds of the time devoted to class work is devoted to practical chemistry. In botany one half the time is given to dissections, schedule writing, and classification.	
KING'S COLLEGE SCHOOL.	One lecture to each class—one hour and a quarter for the higher classes, three-quarters of an hour for the elementary classes. In the *Chemistry Class*, lecture and demonstration, one hour.	Twenty boys do practical Chemistry two hours. One special boy does considerably more. A few boys go into the physical laboratory.	
UNIVERSITY COLLEGE SCHOOL.	Lower fifth form, one hour and a half to chemistry and physics. Upper fifth form, one hour and a half to chemistry, and one hour and a half to chemical physics. Upper sixth form, one hour and a half to chemistry.	Upper sixth form, one hour and a half to practical chemistry. In the New Laboratory, boys can work for a longer time than this; some are working for more than six hours.	
MANCHESTER GRAMMAR SCHOOL.	In the Mathematical VIth, four hours and a half to physics. In the Science VIth, five hours and a quarter to physics, and six hours and three quarters to chemistry. In the Science Transitus, one hour and a half to physics, and six hours and three quarters to chemistry. In the Science Vth, three hours and a half to physics, and five hours and a quarter to chemistry. In the Science Remove, four hours and a half to physics, and three hours to chemistry.	The Science VIth, and Science Transitus receive instruction in practical chemistry four hours per week, exclusive of the usual school hours.	
DULWICH COLLEGE -	*Sixth Form: science students:* during school, four hours. *Additional branch of science,* four hours. *Senior section:* during school, three hours and a half. *Additional branch of science,* two hours.	One hour; for advanced pupils, two hours.	The more advanced pupils, two hours for chemistry, and one hour and a half for physics.

§ 4.—SUBJECTS TAUGHT TO JUNIOR AND SENIOR STUDENTS.

At Eton, the subjects are Chemistry, Heat, and Physical Geography. Mr. Madan points out that Heat, treated in a very simple way, is very attractive to the younger boys. For the senior boys the subjects are Chemistry and Physical Geography; for the juniors, Physical Geography, Astronomy, Mechanics, Hydrostatics, and Heat.

At Harrow, Experimental Physics is the only subject which has been taught in school. A few boys receive instruction in Comparative Anatomy and Physiology during the half holidays, and other times which they can arrange with the teacher.

At Rugby, in the Middle School, and, therefore, with younger boys, the teaching of physics has been found to be less satisfactory than in the Upper School. The subjects that have been tried are hydrostatics and pneumatics, with the elements of heat, but, although most of the boys have shown considerable interest in the *facts and experimental illustrations,* the *power of grasping the principles* and applying their knowledge to easy problems has been acquired comparatively by few. At present the greater number of boys in the Middle School are learning either botany, geology, or elementary physics. In the Sixth Form and Upper School, chemistry and physics are the only subjects taught, with the exception of a short course of physiology. Under physics is at present included heat, magnetism and electricity, and geometrical optics treated experimentally. The experience of the masters goes to show that physics can be taught successfully to a larger proportion of boys than chemistry. Indeed, it would seem that a boy requires an almost special turn of mind to grapple successfully with the ideas involved in chemical affinities and reactions. It is hoped by the masters that, in time, better arrangements may be made for carrying on the instruction in the Natural History side of Science after a boy has reached the Upper School.

At Clifton College the younger boys are taught elementary physics, physical geography, or botany, the subjects being taken in turn. The elder boys learn chemistry and physics. The Head Master says, "So far as I "have been able to arrive at any definite opinion, I "consider this to be the best arrangement of subjects from "a purely educational point of view, provided that it is "supplemented, as with us, by an elastic system of voluntary classes, to facilitate the development of individual "tastes. I consider that every branch of scientific teaching which we have tried has been fairly successful, quite "as much so as could have been expected in the case of "new studies. More particularly, I should speak of "chemistry and physics as having proved a valuable "addition to our school work in the middle and upper "parts of the school, whilst the same may be said of "botany, physical geography, and elementary physics "among the younger boys, and of geology as taught to a "voluntary class."

At Dulwich College a continuous course of instruction is given in chemistry. Instruction is given in each Term in two or more additional branches of Science—heat, electricity, magnetism, geology. The younger boys generally begin their Science Studies with Physics, but a considerable proportion of them join at the same time the Elementary Chemistry Class. The Master of the College says, "I am decidedly of opinion that chemistry possesses "the greatest educational value."

At Marlborough College, physics and chemistry receive most attention. The Head Master observes: “I cannot say what branch of science has the greatest educational value. I should think, as matter of individual opinion (not of experience), the following subjects would be most valuable:—

a. For young boys:

Elementary botany.
,, chemistry.
,, mechanics, pneumatics, hydrostatics, and hydraulics.

b. For boys between the middle fourth and the fifths:

Elementary heat.
,, electricity.
,, magnetism.
,, sound.
,, light.
,, chemistry.

c. For boys in and above the fifths:

Mechanics, electricity, magnetism, heat, chemistry.
Elementary astronomy.
Elementary physiology.

“Series of lectures have from time to time been given by different masters on geology, animal physiology, botany, &c., with satisfactory results in increasing the stock of knowledge possessed by a good many boys, and giving a marked stimulus to a few.”

At Winchester College the subject which receives most attention is the surface of the earth, there being always a class in geology; in summer there are several classes in botany. Other branches of physics are taken in a cycle. The Head Master does “not think there is any special educational value in the lessons different from what is derived from lessons in other subjects given in the same way. The geological and botanical courses, which cause actual acquaintance with specimens, are the only ones that seem special. Physical Geography has been successfully taught. The Experimental Courses in Physics interest a good many boys, and give them new ideas. Electricity seems to be the best subject; Chemistry, as taught in courses of lectures, does not seem to answer.”

At St. Peter's College, Westminster, applied physics is the only branch which has as yet been attempted: “A course of lectures on Heat seemed to answer best for the classes generally, but the subject of Electricity was more interesting to a few of the best pupils.”

At Cheltenham College the subjects chosen are practically determined by the examinations for which the boys are preparing, *e.g.* in the Classical Department for scholarships at the Universities and for the Indian Civil Service. In the Military Department the boys are first taught the chief facts and principles of physical science. Chemistry is not taught till a boy reaches the first class, and then it is studied theoretically and practically. In this class, chemistry and heat are alternative subjects, with magnetism and electricity, or with geology and physical geography. “From a purely educational point of view,” the Principal considers “Physical Geography, from its aptitude for varied and familiar illustration from History—and Botany, from its power of developing observation in the country walks of every day—the best subjects for young boys. Afterwards, severer and more strictly scientific subjects.”

At Wellington College, in the *Classical Sixth*, an elementary course, lasting about two years and a half, comprising Mechanics, Astronomy, Heat, Steam, the first principles of Chemistry, and Electricity. In the *Modern School*, in the lower classes, Physical Geography, Heat, and Elementary Chemistry; in the upper classes, chiefly Electricity and Magnetism (for Woolwich); also, occasionally, Light and Heat. In the *highest Mathematical set of the Modern School*, Mathematics and Hydrostatics.

At Rossall School, chemistry has been always held to be the chief subject in Natural Science. The Head Master states that “as, according to his experience, Natural Science in schools, as an instrument of education, can only be useful in developing the observation and not the memory, much less the judgment, I am inclined to think that the branches that can be best illustrated by specimens and experiments must really have the greatest educational value. If science is to be taught as an accomplishment, like conversational French, for practical use, then probably chemistry and geology are the most important.” He continues, “Geology, to a select class of volunteers, has been very fairly taught during the last quarter by lectures once a week illustrated by diagrams.”

At Charterhouse School, as yet, only botany and chemistry have been attempted. Botany was taught in the summer quarter, but it was not a popular subject. Theoretical chemistry, the subject for the winter quarter, is popular with most of the boys. Practical chemistry cannot be taught at this school till the laboratory is completed.

At Christ's Hospital the classes of chemistry and natural philosophy have been barely two years at work, and it is hardly possible to judge with what success at present. A very high educational value is attached at this school to the training in mathematical science given in Classes I. and II. Every boy in Classes III.–VI. gives at least one hour a week during half a year to Natural Philosophy (oral lectures with apparatus and experiments), as an introduction to the chemistry class, in which he stays at least half a year. Those who show any special aptitude are allowed to continue chemistry, and promoted to the practical class. Further, the boys in III. and V. learn elementary mechanics in the Mathematical School as soon as they are qualified by their mathematical knowledge. In Classes I., II. Mathematical science (statics, dynamics, hydrostatics, optics, astronomy), is studied in preparation for the Universities, and carried to a high point. The boys in Class X. give one hour a week to very elementary Natural Philosophy (oral lecture with experiments).

At the City of London School most attention is given to chemistry in the lower school, and to chemistry and physics in the higher school.

At Taunton College School, the most popular subjects are chemistry and botany. The Head Master says that he believes this “is due to the special enthusiasm displayed in teaching these subjects, not to any interest inherent in the subjects. The most zealous and effective teacher will make his own subject the most popular, or, teaching several subjects, the subject which he loves best.”

At University College School, the subjects taught are: Physical Geography; Chemistry, theoretical and practical; Chemical Physics; Natural Philosophy; Astronomy; Applied Mathematics.

At King's College School chemistry and natural philosophy are the subjects which receive most attention.

At the Grammar School, Manchester, physics and chemistry receive an equal degree of attention. At this school it is found that beginners appear to derive most profit from acoustics, and the more advanced students from optics and chemistry, electricity and heat occupying an intermediate position.

That physics, rather than chemistry, will be found the best subject for boys to begin with, appears to be borne out by the following return (furnished by the Natural Science Master) of the averages of marks obtained at the last examination at Marlborough College. Max. = 100:—

Upper voluntary (from the fifths)	Electricity	59·14
,, ,,	Chemistry	35·55
Upper shell ,,	,,	31·48
,, fourths (A) ,,	,,	29·31
,, ,, (B) ,,	,,	26·16
Lower voluntary (from three preceding forms)	Electricity	42·03
Upper division Modern School	,,	49·49
,, ,,	Chemistry	26·07
Middle division ,,	Electricity	36·58
,, ,,	Chemistry	17·90
Lower division ,,	Electricity	24·41
,, ,,	Properties of Matter	35·05
Woolwich class	Heat	36·07

Further important evidence in support of this view comes from the Head Master of Christ's Hospital. He says, “My experience is but short, but I have found already that the plan often adopted of teaching chemistry as the first subject, is not satisfactory. I attended an admirable course of lectures given by the late Dr. Matthiessen to a class of our boys, who had had no previous scientific instruction in Natural Science. It was obvious that most of it was lost upon them for want of familiarity with simple scientific notions; and we found it necessary to institute the Natural Philosophy class as an introduction to the Chemistry class.” In this remark, the Head Master of King's College School fully concurs.

§ 5.—TEXT BOOKS IN USE AT THE SEVERAL COLLEGES AND SCHOOLS.

College or School.	Acoustics.	Astronomy.	Botany.	Chemistry.	Geology.	Heat.	Hydrostatics.
Eton College - -	- - -	Lockyer's Astronomy (*b.*)	- - -	Wilson's Chemistry (*b.*); Chambers's Course (*b.*); Harcourt and Madan's Practical Chemistry (*b.*); Fownes' Chemistry (*a.*); Fresenius's Qualitative Analysis (*a.*).	Lyell's Elements and Principles, in the small select class.	Tyndall on Heat, in the small select class.	—
Harrow School -	Tyndall on Sound (Modern Side).	Lockyer's Astronomy (Modern Side).	- - -	- - - - - -	- - -	Maxwell on Heat (Modern Side).	—
Rugby School - -	- - -	Lockyer's Astronomy (*b.*)	Oliver's Elementary Botany (*b.*); Asa Gray's Class Book of Botany, and Bentham's British Flora (*a.*).	Roscoe's Chemistry (*a.*); Harcourt and Madan's Practical Chemistry, and Fresenius's Qualitative Analysis (*c.*).	Jukes' School Manual of Geology (*b.*).	Deschanel's Natural Philosophy (*a.*).	—
Clifton College -	- - -	- - -	Oliver's Botany; Balfour's Outlines.	Roscoe is at present the book generally used, but this is about to be replaced gradually by Miller's Text-book of Inorganic Chemistry. Cooke's First Principles of Chemical Philosophy, for special classes. Miller's Elements of Chemistry, for the Lower Divisions. Harcourt and Madan's Practical Chemistry, with MS. notes, tables, &c., supplied by the master in the laboratory.	Page's Small Handbook. Jukes and Geikie.	—	—
Marlborough College -	- - -	- - -	- - -	W. A. Miller's Elementary Chemistry (*a.*). Roscoe's Elementary Chemistry Primer (*b.*).	- - -	Tyndall on Heat as a Mode of Motion (*d.*).	—
Winchester College -	- - -	Lockyer's Astronomy.	Oliver's Botany. -	- - - - - -	Page's Geology; Jukes' Geology.	Tyndall on Heat. -	—
St. Peter's College, Westminster.	- - -	- -	- - -	- - - - - -	- - -	Balfour Stewart on Heat (*a.*).	—
Wellington College -	- - -	- -	- - -	Barff's Chemistry (*a.* & *b.*). - -	- - -	Orme on Heat (*a.* & *b.*); Ganot's Physics (*a.*).	Besant's Hydrostatics (*a*).

(*a.*) Senior boys. (*b.*) Junior boys. (*c.*) Laboratory practice. (*d.*) Special pupils.

continued

College or School.	Magnetism and Electricity.	Mechanics.	Optics.	Physical Geography.	Physics, generally.	Physiology.	Zoology.
Eton College -	- -	- - -	- - -	Keith Johnston's Physical Atlas for Schools (for all boys). In the small select class, individual boys have used Mrs. Somerville's Physical Geography; Herschel's Physical Geography.	Balfour Stewart's Elementary Physics (*b.*); Ganot's Physics (*a.*).	—	—
Harrow School -	- - -	- - -	- - -	- - -	Deschanel's Physics (Modern Side).	—	—
Rugby School -	Ganot's Physics, for Electricity and Magnetism (*a.*).	- - -	Airy's Geometrical Optics (*a.*).	- - -	Balfour Stewart's Physics (*b.*).	—	—
Clifton College -	Deschanel's Electricity.	Todhunter's Mechanics, in the upper class.	- - -	- - -	Deschanel's Natural Philosophy, in the upper class. Balfour Stewart's Physics, in the lower class; do. do. Primer, for the youngest boys.	Kirke. Rolleston's Forms of Animal Life.	Nicholson's Manual.
Marlborough College -	Deschanel's Electricity and Magnetism.	- - -	- - -	Hughes's Physical Geography.	Privet-Deschanel's Natural Philosophy; (*a.*). B. Stewart's Elementary Physics Primer (*b.*). Ganot's Smaller Physics (*d.*).	Huxley's Elementary Physiology (*d.*).	—
Winchester College -	- - -	- - -	- - -	- - -	Ganot's Physics; Balfour Stewart's Physics.	—	—
St. Peter's College, Westminster.	Ferguson on Electricity (*a.*). Gleig's series, Tate's Electricity (*b*); do. do. Magnetism, &c. (*b.*)	- - -	- - -	Ansted's and Hughes' Physical Geography (*a.*).	—	—	—
Wellington College -	Deschanel's Electricity (Everett); Ferguson's Electricity (both by the seniors chiefly).	Goodwin's Statics and Dynamics (*a.*); Todhunter's Elementary Mechanics (*a.*).	Herschel's Familiar Lectures (*a.*); Ganot's Physics (*a.*).	—	—	—	—

(*a.*) Senior boys. (*b.*) Junior boys. (*c.*) Laboratory practice. (*d.*) Special pupils.

continued.

College or School.	Acoustics.	Astronomy.	Botany.	Chemistry.	Geology.	Heat.	Hydrostatics.
Cheltenham College -	- - -	- - -	Classical department:—Balfour's Elements of Botany (*b.*); Balfour's Manual of Botany. (*a.*)	Classical department:—Roscoe's Elementary Chemistry (*b.*); Harcourt and Madan's Practical Chemistry (*a.*). Military department:—Roscoe's Lessons in Elementary Chemistry (*b.*); Fresenius's Qualitative Analysis; Liveing's Tables (*a.*).	Military department:—Jukes' School Manual of Geology (*b.*); Lyell's Elements and Principles (*a.*).	Balfour Stewart on Heat (*b.*); Deschanel's Natural Philosophy (*a.*); Ganot's Physics (*a.*).	—
Rossall School -	- - -	- - -	- - -	Roscoe's Chemistry; Gill's Chemistry for Schools.	Page's Geology.	—	—
Charterhouse School -	- - -	- - -	Oliver's First Lessons in Elementary Botany (*a.* & *b.*).	Roscoe's Chemistry (*a.*); Barff's Introduction (*b.*).	—	—	—
Christ's Hospital School	Tyndall on Sound (*a.*).	Godfrey's Astronomy (*a.*)	- - -	Barff's Manual of Chemistry (*b.*); (Roscoe and Gill occasionally) (*b.*).	- - -	Maxwell on Heat (*a.*); Tyndall on Heat (*a.*).	Besant's Hydrostatics (*a.*); Hamblin Smith's Hydrostatics (*b.*), Galbraith and Haughton's Hydrostatics and Mechanics (*b.*).
City of London School	Lee's Acoustics. -	- - -	Oliver's Botany (*a.*). -	Jarmain's Qualitative Analysis (*a.*); Fownes' Chemistry (*a.*); Miller's Chemistry (*a.*); Hall's Chemistry (*b.*), Buckmaster's Chemistry (Inorganic) (*b.*).	Lyell's Geology (*a.*). -	Tate's Heat, &c. (*a.*); Lee's Light and Heat.	
Dulwich College -	- - -	- - -	- - -	1st Class:—Miller's Inorganic Chemistry (*a*); Gill's Chemistry for Schools (*a*); Harcourt and Madan's Practical Chemistry (*a*); Fresenius's Qualitative Analysis (*a.*). 2nd Class:—Roscoe's Chemistry ("Science Primer") (*b*).	1st Class — Jukes' Student's Manual of Geology (*a*). 2nd Class:—Page's Introductory Text Book (*b*); Jukes' School Manual of Geology (*b*).	—	Besant's Hydrostatics.
Taunton College School	- - -	- -	Oliver's Botany (*a.*); Lindley's Descriptive Botany (*a.*).	Roscoe's Chemistry (*a.*). - - -	—	—	
King's College School -	- - -	- - -	- - -	Miller's Introductory Text Book. Roscoe's Chemistry Class Book.	- - -	- - -	Besant's Hydrostatics.
University College School.	- - -	- - -	- - -	Gill's Chemistry for Schools (*a.*). -	- - -	Orme's Science of Heat (*a.*).	(None.)
Manchester Grammar School.	Tyndall on Sound (*a.*); Lee's Acoustics, &c. (*b.*)	- - -	- - -	Roscoe's Chemistry (*a.* & *b.*); Bloxam's Metallurgy (*a.*); Fownes' Chemistry (*a.*).	- - -	Balfour Stewart's Treatise on Heat (*a.*).	

(*a.*) Senior boys. (*b.*) Junior boys. (*c.*) Laboratory practice. (*d.*) Special pupils.

continued.

College or School.	Magnetism and Electricity.	Mechanics.	Optics.	Physical Geography.	Physics, generally.	Physiology.	Zoology.
Cheltenham College -	Classical and Military departments :—Deschanel's Electricity (*b.*) ; Ferguson's Electricity (*a.*) ; Ganot's Physics(*a.*); Tyndall's Notes (*a.*).	Military Department : Deschanel (*a.*); Ganot (*a.*); Tyndall (*a.*); Balfour Stewart (*b.*).	- - -	- - -	Classical Department :—Balfour Stewart's Elementary Physics (*b.*). Military department:—Balfour Stewart's Elementary Physics (*b.*) ; Ganot's Physics (Atkinson). (*a.*)	—	—
Rossall School -	—	—	—	—	—	—	—
Charterhouse School -	—	—	—	—	—	—	—
Christ's Hospital School	- - -	Todhunter's Elementary Mechanics (*a.*); Parkinson's ditto (*a.*) ; Todhunter's Analytical Statics (*a.*)	Parkinson's Optics (*a.*).	- - -	Deschanel's Traité de Physique (*a.*) ; Balfour Stewart's Lessons in Elementary Physics, Balfour Stewart's Science Primer (*b.*).	—	—
City of London School -	Ferguson's Electricity (*b*).	- - -	- - -	In a small class: Ansted; Herschel; Skertchley; Ramsay.	Balfour Stewart's Elementary Physics (*a.*); Ganot's Physics (*a.*); Brook's Natural Philosophy (*a.*) ; Lardner's Handbook of Natural Philosophy (4 vols.), (*a.*).	Carpenter's Animal Physiology (*a.*); Carpenter's Vegetable Physiology (*a.*). ; Huxley's Physiology.	—
Dulwich College -	Deschanel's Electricity and Magnetism.	Todhunter's Mechanics	- - -	Hughes's Physical Geography ; Maury's Physical Geography of the Sea ; Student's Manual of Modern Geography.	Balfour Stewart's Elementary Physics (*a.*) ; Deschanel's Natural Philosophy (*a.*).	—	—
Taunton College School	- - -	Twisden's Practical Mechanics (*a*).	- - -	- - -	Newth's Natural Philosophy and Mechanics (*a.*).	Huxley's Physiology (*a.*).	—
King's College School -	Ferguson's Electricity.	Parkinson's Mechanics. Todhunter's Mechanics.	- - -	- -	Ganot's Physics.	—	—
University College School.	(None)	(None)	(None)	Page's Physical Geography.	—	—	—
Manchester Grammar School.	Ferguson's Electricity ; Jenkin's Magnetism and Electricity (*a.*).	Todhunter's Mechanics; Goodwin's Statics.	Ganot's Physics ; Deschanel's Light ; Tyndall's Notes on Light.	Ansted's Physical Geography (*a.*) ; Macturk's Physical Geography (*b.*).	Balfour Stewart's Lessons on Elementary Physics (*b.*) ; Ganot's Physics by Atkinson (*a.*); Deschanel's Natural Philosophy by Everett (*a.*).	—	—

(*a.*) Senior boys. (*b.*) Junior boys. (*c.*) Laboratory practice. (*d.*) Special pupils.

§ 6.—WEIGHT ASSIGNED TO SCIENTIFIC ATTAINMENTS IN DETERMINING A BOY'S POSITION IN THE SCHOOL.

At St. Peter's College, Westminster, the weight assigned is very small.

At Christ's Hospital, the Head Master states, "the highest position in the school, which brings the most substantial rewards, is that of Grecian. A boy who, in Classes 2 and 3, shows a marked aptitude for science, is encouraged to pursue it, and if his progress continues satisfactory, is made Grecian, even though he may make little progress in classics. Two boys have thus been recently elected at Cooper's Hill College, who had been kept till 18 as Grecians by reason of their aptitude for science and mathematics: one boy has just been elected to a Physical Science Exhibition at Oxford, and he has had an Exhibition granted to him by the Governors almost entirely by reason of his proficiency in science. It is my hope," the Head Master continues, "that we shall have a succession of similar cases, so that it is not strictly accurate to say that 'the weight assigned to 'scientific attainments in determining a boy's position in 'the school is *practically nil*.'"

At Charterhouse School it is considered that the amount of acquirement would not at present justify any weight being assigned to scientific attainments for determining the position in the school; but as advance is made, this, it is stated, will be remedied.

At King's College School no weight is assigned in determining a boy's position in the school, but his marks for science are added to his class marks to obtain a prize.

At the City of London School, the weight assigned to scientific attainments in determining promotion and in awarding scholarships is one third of that assigned to Mathematics or to Classics.

At Rugby School, the proportion of the marks for different subjects, both for terms' work and examination, is given below.

Upper School.

	Terms' mark.	Exam. mark.
Classics and English	39	33
Mathematics	6	6
German or Natural Science	3	3
French	2	2

Middle School.

	Terms' mark.	Exam. mark.
Classics and English	36	33
Mathematics	6	5
Natural Science	4	2
French and German	4	3

In the higher part of the school, a boy who shows ability may be allowed to drop verses, together with a certain amount of general classical work, and devote the extra time to mathematics or Natural Science. The important fact is, that by so doing he does not lower his position in the school or lessen the chance of future promotion, as he receives a full equivalent of marks for actual work.

At Eton, in the "trials" for school promotion into the Middle division of the 5th Form, and into the Upper division, *one* Science paper is set. The papers are 12 in all.

At Harrow, the same weight is assigned as to other subjects, the proportions being determined by the time given to the several subjects.

At Clifton College, marks are assigned for each hour of scientific work just as for any other kind of work, and on the same scale, the principle being to award a fixed number of marks for every hour's work, whatever the subject.

At Wellington College, in the Classical Sixth, the science-lessons are 1-15th of the classical lessons in hours, but have 1-10th of the marks of the classics.

Classics	600
Mathematics	360
German	180
Drawing	60
Science	60

In Mathematical School—

Mathematics	400 (lower forms 300)
Modern languages	300
Latin	150
Science	100

At Winchester College, about one tenth of the whole marks in class work and examinations.

At Rossall School, in the Modern Side, about 10 per cent. of weekly marks, determining the boys' places, are allowed to the Natural Science lessons.

At Marlborough College, there are marks assigned to each boy who does Science in some Forms in his weekly work, and in others in quarterly examinations. These marks are added into the total to assign his final place. The exact proportion observed in adding the Science marks to those attained in other subjects probably varies to a certain extent in different Forms; but in every Form a boy would gain very considerably by having really distinguished himself in the science work.

At Dulwich College, the classification for science is entirely independent. Prizes are awarded in each class at the annual examination. In the award of exhibitions 200 marks are assigned to science as against 220 to English, 220 to Latin, 150 to each modern language, 150 to elementary mathematics, and 300 to the higher mathematics.

At Cheltenham College, in the Classical Department, 7 per cent. in marks of the half year, in examination 12½ per cent.: in the Military Department not quite 20 per cent.

At the Manchester Grammar School a boy's position in the Science forms, and his prospects of promotion, depend almost entirely on his scientific attainments. The Science and Mathematical forms are regarded as equal to the highest classical forms.

At Taunton College School it is the desire to give exactly the same value in school marks to science, mathematics and languages.

In University College School, "the foremost place in the Science Classes is sought for with the same interest and eagerness which attend the struggle for corresponding distinction in the traditional and more generally established subjects of school education." [Appendix III., p. 119].

---

§ 7.—METHODS OF TEACHING AS REGARDS ORAL DEMONSTRATION, BOOK WORK, AND PRACTICAL WORK.

The Commissioners will gather from the answers to questions 10 and 11, that mere book work in Science teaching is practically dead in all those public and first grade schools from which returns have been received; but I think I shall not be wrong in stating that this opinion is to be gathered in a much more definite way from actual inspection of the schools than from the returns.

From Christ's Hospital we are told "there is no doubt that . . . . oral teaching by a good teacher is far more effective than any book can be;" at Rugby and many other schools book work is stated to be only "supplementary" to a lesson; at Rossall it is "subsidiary;" at Clifton the boys are "generally expected to read certain portions of the text-book in use as preparation for each lesson;" at Winchester the book is abolished altogether for the lower classes; at Wellington College books are not used more than twice or three times in a term; and at Marlborough the possession and use of text-books is not compulsory, except in the middle divisions A and B of the Modern School.

This being so, we come to oral demonstration and practical work. In schools where there is no opportunity for practical work, I find the lecture system thought a great deal of; but, at the same time, I think there is evidence that where there are opportunities for practical work, the more developed the practical work is, and the more perfect the laboratory arrangements, the more is practical work preferred to oral demonstration, much more time being allowed to be given to it, and oral demonstration, in some cases, altogether dispensed with in the case of volunteers for laboratory practice. Although I am aware that these circumstances arise, to a certain extent, from the local teaching conditions, still we must assume that they would not be permitted if it were not agreed among the teachers that such proceedings were educationally sound.

The following table shows the relative proportion of oral demonstration and book work in the lessons, and the subjects which are taught practically in the various schools :—

College or School.	Lessons.		Practical Work.
	Oral Teaching and Demonstration.	Book Work.	
Eton	All	Subsidiary and supplementary.	Practical work in the laboratory is done entirely out of school, the time devoted to it being from 3 to 3½ hours in each week. The time spent in regular school lessons is about one half of this.
Rugby	All	Supplementary	Botany in lessons, chemistry in laboratory.
Clifton	All, when not catechetical, or occupied with working out examples and propositions.	Preparatory or supplementary.	Botany in lessons, botanical and geological expeditions, chemistry.
Marlborough	All	Preparatory	Various branches of Natural History.
Winchester	All in lower classes Part in upper classes	Nil Part in upper classes	Nil.
Westminster	All	Preparatory and supplementary.	Nil.
Cheltenham	From one fourth to one half	Varying with subject and with master.*	Botany, electricity, chemistry in lessons.
Wellington	Two thirds	Supplementary	Electrical measurements in lessons, chemistry in laboratory (voluntary).
Rossall	Lectures followed by oral and written examinations.	Subsidiary to lectures	Chemistry in the laboratory.
Charterhouse	All	Supplementary	Nil.
Christ's Hospital	Chemistry, one half; natural philosophy, three fourths; elementary mechanics, and examples are set to be worked from books.	Chemistry, one half; natural philosophy, one fourth; supplementary and to supply problems and examples.	Chemistry in laboratory.
City of London School	All	Preparatory at home	Chemistry in laboratory. Also, with a select few, Experimental Physics, Physiology, and Botany.
Taunton College School	Of physiology, all; of botany, one half; of chemistry, for the Upper School, one third; for the Middle School, all; of mechanics, all.	Out of school as an assistance to notes taken at the lectures.	Botany, half of each lesson employed in dissections, schedule writing, and classification; chemistry in laboratory.
Dulwich College	Each of the classes receives two lessons per week of an hour or an hour and a quarter each. A course of evening lectures (generally four or five lectures) on some branch of science is also given in each term. Attendance at these lectures is voluntary. They are open to all boys, whether pupils in any of the science classes or not.	Book work is got up during the "preparation time," which, for the more advanced pupils, amounts to about two hours for chemistry and one hour and a half for physics.	Chemistry in laboratory, one hour a week: for advanced pupils, two hours; out of ordinary school hours. Physics in laboratory, during the school time assigned to the Science lesson.
University College School.	In chemistry and chemical physics, the subjects are explained solely by means of oral teaching and demonstration, no portion of any lesson being ever devoted to book work. This oral teaching includes the explanation of those portions of science which the boys are expected by the Universities to know, but which are not capable of experimental proof in the class rooms of a school. All the subjects in physics and mechanics are explained by means of oral teaching and demonstration, no books being used. The lessons are alternately devoted to experimental demonstrations of general principles and to the working of illustrative exercises and problems on, or deductions from, these principles.	Preparatory at home	Chemistry in laboratory, accompanied by oral teaching; and occasionally there is added such further demonstration as is considered necessary to supplement the experiments made by the boys themselves. [A laboratory for physics has been recently constructed in the new building.]
King's College School	Physical classes, one half	One half	Chemistry in laboratory; physics in laboratory.
Manchester Grammar School.	All, with very few exceptions	Preparatory, excepting when used in the absence of large diagrams.	Chemistry in laboratory. Optical, heat, and electrical experiments.

[*NOTE.—Masters and methods differ; subjects differ also. One master would reply, chiefly preparatory; both for first (or demonstrative) lesson, and also for last (or catechetical) lesson. Another master would say, simply preparatory, except so far as useful for revision of work before examination. The Head Master of the Military Department, a man of great experience and great wisdom in teaching, who himself taught science for many years before any special master for science was appointed, says: "The subject matter of each lesson should generally be explained in advance; it is then learnt from text-books during preparation hours, and tested at the next lesson time. If any points are not clearly understood, they are again explained, and notes made by the boys."]

§ 8.—TESTS OF PROGRESS.

Intermediate Examinations.

The tests of progress adopted at the several schools may be classed under the following heads, viz.:—

1. An oral examination after each lesson or lecture.
2. A written examination after each lesson or lecture.
3. An examination of note books.
4. Intermediate examinations.

At the Manchester Grammar School the first method is adopted.

At the City of London School and King's College School the first and third methods are adopted, with the addition of the following tests in the case of the City of London School:—For "home work" the boys have to write answers to certain questions on the subjects treated of in the lecture. These answers are brought on the next lesson day. In the Lower School the boys have to bring drawings of the apparatus and experiments shown at the lecture. Boys who take an interest in the subject are encouraged to remain after the lesson to receive extra instruction, and to try the experiments for themselves.

At Christ's Hospital the second and third methods are adopted, the latter for the chemistry class.

At University College School the first and third methods are adopted, together with monthly intermediate examinations.

At Eton, a part of each lesson is spent in putting questions on the previous lesson. Note books or abstracts of lessons are looked over and marked once a week. Once in three or four weeks there is a written examination; three times a year, by a paper on the work of the school time.

At Clifton College and Wellington College there is an examination of note books and there are also intermediate examinations every three weeks or so.

At St. Peter's College, Westminster, there are weekly examinations.

At Marlborough College, questions are put, and when a boy answers badly, his note book is examined, and, if insufficient, is filled up out of school, or re-written. Examinations are held at the end of the Term.

At Cheltenham College and Taunton College School the examinations are monthly.

At Rugby School, Winchester College, and Charterhouse School there are frequent examinations during the term.

At Harrow, the note books are examined once a week, or oftener.

At Dulwich College there are written examinations two or three times each Term, by the Teacher, who looks over and corrects the boys' note-books from time to time.

I append some of the intermediate examination papers handed to me at Clifton (where this method of testing is carried out in a most complete manner), together with some of the terminal examination papers.

These examinations are held once in three weeks: the teacher sets and looks over the papers on his own subjects. This is considered necessary as a means of showing him where his teaching is successful, and where and how it is failing. These papers with the marks and reports all pass through the hands of the Head Master when they have been looked over by the Master, before being given back to the boys.

Terminal Examinations.

These examinations, which take place at the end of term or half yearly, are generally conducted by independent examiners.

At Eton, a general yearly examination ("trials") is held for deciding places in the school, and a paper on the scientific work of the school for that year is set.

At Harrow, the terminal examinations in science are conducted by the teacher; but, once a year, there is an examination in the work of the year for two prizes given by the Head Master. This is conducted by an independent examiner (generally from Oxford or Cambridge).

At Dulwich College Terminal Examinations are held at the end of the First and Third Terms. There is also an Annual Examination, conducted by an Independent Examiner. The Order of Merit and the award of Prizes are determined by a combination, in equal proportions, of the marks assigned by the Examiner, and those gained by school-work in the previous half-year.

It is stated that at Rossall a written examination, usually conducted by an outsider, is generally accompanied by "unsatisfactory results."

At Clifton, at the end of the summer term, which completes the school year, the work is examined by an examiner from one of the Universities. At the end of each of the other two terms, the masters examine and report upon each other's work, it being a rule that, where it can be avoided, no one examines his own work.

SPECIMENS OF INTERMEDIATE AND TERMINAL EXAMINATION PAPERS.

CLIFTON COLLEGE.

INTERMEDIATE EXAMINATION.—February 13th, 1871.

BOTANY.

III. α. and III. β. To be written on separate paper.

1. What is the "receptacle"? Sketch and describe its form in the geranium and strawberry.

2. Give the meanings of these words: *perianth, polysepalous, aestivation, stigma, distractile connective.*

3. Describe the structure of the stamen, and show how its parts correspond with those of the ordinary green leaf.

4. In what way are the floral leaves of the sweet pea arranged in the bud?

5. What forms of the calyx are found in the dandelion, daisy, and gooseberry?

6. Sketch and name some of the chief varieties of the regular gamopetalous corolla.

INTERMEDIATE EXAMINATION.—February 27th, 1871.

BOTANY, III. α. and β.

Half of the time allotted for the examination is expected to be given to this paper.

1. Give a minute account of the various parts of a stamen, and refer each one to its corresponding portion in the ordinary green leaf.

2. How many stamens are found in these plants:—*Wallflower, dead nettle, sweet pea?*

3. What do these terms mean: *Monadelphous, diadelphous, polyadelphous?* Give examples.

4. Write down the terms applied to the anther in the following conditions:—

(α.) Filament adhering along the whole length of the "back."

(β.) Filament extending only to the base of the lobes.

(γ.) Apex of filament attached to a single point only.

5. How does the pollen escape from the anther?

6. Describe the structure of the pistil in the pea. Distinguish clearly between its two sutures, and compare it with a foliage leaf.

TERMINAL EXAMINATION.—Easter, 1871.

BOTANY IIIα. & β.—Junior School, IVα. & β., III.

Examiner, Rev. G. Macloskie, LL.D.

1. What is meant by the word "superior," with reference to the calyx and ovary? Give examples of a superior and an inferior ovary.

2. Describe the petals, the stamens, and the fruit in a *Cruciferous* plant.

3. Give, very briefly, the meanings of these words:—

Epicalyx
Papilionaceous
Polyadelphous

Introrse
Syncarpous
Dehiscence

Pome
Achene
Cone

4. What is remarkable about the calyx, corolla, and anthers in the dandelion or thistle?

5. Show how these three fruits differ: Strawberry, blackberry, and mulberry.

6. Describe the fruit called a "legume." Show how it resembles an ordinary leaf, and contrast it with the "follicle."

7. Name the principal forms of cells and vessels.

8. Distinguish between the exogenous, endogenous, and acrogenous stem. Give examples.

9. What action have plants upon the atmosphere?

Candidates are not expected to write upon more than six questions, and a few good answers will receive more marks than a larger quantity of inferior ones.

INTERMEDIATE EXAMINATION.—October 20th, 1873.

CHEMISTRY.

VI., V., and First Set below V.

1. How would you make nitric acid? Calculate the weight of nitric acid obtainable from 20 ounces of nitre. $K = 39 \cdot 1$.

2. Give the formulæ for nitric anhydride and nitrous anhydride, and show the action of water upon them.

3. Give equations showing the action of heat on ammonium nitrite and ammonium nitrate.

4. Describe the properties of nitric oxide, and the process by which it is usually made.

First Set, Modern.

1. Describe, as fully as you can, the process for estimating the carbon and hydrogen in benzoic acid, $C_7H_6O_2$.

2. One hundred parts of an organic compound contain carbon $63 \cdot 15$, hydrogen $3 \cdot 17$, oxygen $33 \cdot 68$. Find the formula, assuming its molecular weight $= 190$.

3. Explain the processes both of experiment and reasoning by which you would establish the formula $C_2H_4O_2$ for acetic acid.

Second Set Classical, and Second Set Modern.

1. Describe fully, with equations, the preparation and properties of hydrogen nitrate (nitric acid).

2. Complete the following equations, adding the name to each formula:—

$Zn+2HCl=$
$Fe+H_2SO_4=$
$3Cu+6HNO_3+2HNO_3=$
$Cu+H_2SO_4+H_2SO_4=$
NH_4NO_2 heated $=$
NH_4NO_3 heated $=$

3. Give the names and formulæ of all the oxides of nitrogen, and describe the properties of *one* of them.

Third Set, below Fifth Classical.

1. Composition of the air, and the action of animals and plants upon it.

2. Give three ways of preparing oxygen gas.

3. Describe the action of sodium upon water.

4. Put into words:—

$K, Na, P, H_2O, CO_2, Fe_3O_4, SO_2$.

Third Set, Modern.

1. Describe the preparation and properties of nitric acid.

2. $3Cu+8HNO_3=3Cu(NO_3)_2+4H_2O+2NO$. Read this; give molecular weights of each substance, and the whole relative weights.

3. How much NO will 100 lbs. Cu give?

4. Name the following substances:—HCl, $ZnSO_4$, $KHSO_4$, KHO, H_3PO_4, N_2O_3.

Fourth Set, Modern.

1. When phosphorus is burned in a bell-jar standing on a vessel of water, what happens, and why?

2. What is the composition of the air, and what is the action of plants and animals on it?

3. If sulphuric acid (hydrogen sulphate) is put into a flask containing zinc and water, what gas is formed and what are the properties of this gas?

4. Put into words:—

$Zn, P, K, Na, H_2O, P_2O_5, MnO_2, H_2SO_4$.

PHYSICS.

VI., V., and 1st Set IVths. } 1—6.
I. and II. Moderns.
2nd Set IVths. 1—4.

1. What is meant by the co-efficient of linear expansion? Given the linear, find the superficial and cubical co-efficients.

2. Give some instances where the expansion of metals by heat has to be allowed for.

3. Explain how the fixed points are determined for a thermometer. Find a formula for changing temperatures reckoned on the centigrade scale to the corresponding temperatures on the Fahrenheit scale. Find what temperature on centigrade scale is equal to 68 on Fahrenheit.

4. What corrections and precautions must be applied to get the true temperature from the readings of a thermometer.

5. Distinguish between conduction and convection of heat. Describe some means of determining the relative conductivity of metals.

6. Describe fully the principle of Dulong and Petit's method for determining the absolute dilatation of mercury.

Third Set, below 5th. Classical.

1. Prove the expansion of liquids, solids, and gases by heat.

2. Explain the difference between Fahrenheit, Centigrade, maximum, and minimum thermometers.

3. When a bar of iron and copper are riveted together and then heated, what happens, and why?

4. Describe any applications of the unequal expansion of metals by heat.

Modern Side, Third Set.

1. Define the term force—give a list of the principal forces, and describe an experiment to illustrate the mutual convertibility of several of them.

2. Illustrate inertia.

3. Explain what is meant by the resultant of two or more forces; and give a diagram showing the magnitude and direction of two forces of 4 lbs. and 7 lbs. acting on a point at right angles to each other.

Fourth Set, Modern.

1. Explain what is meant by "gravitation" and "cohesion."

2. How do solids, liquids, and gases differ from each other?

3. Water finds its own level. Explain this.

4. What is meant by specific gravity? How do you find specific gravity of liquids?

INTERMEDIATE EXAMINATION.—November 10th, 1873.

You are requested to divide your time as evenly as possible between the two subjects of examination.

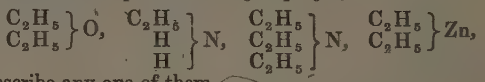
CHEMISTRY.

First Modern Set.

1. Describe the preparation and properties of marsh gas, and give its graphic formula.

2. Describe the preparation of common alcohol, and give equations showing the action of potassium, sulphuric acid, and acetic acid upon it.

3. Name the compound $CHCl_3$, C_2H_5H,



$$\left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\} O, \quad \left.\begin{matrix} C_2H_5 \\ H \\ H \end{matrix}\right\} N, \quad \left.\begin{matrix} C_2H_5 \\ C_2H_5 \\ C_2H_5 \end{matrix}\right\} N, \quad \left.\begin{matrix} C_2H_5 \\ C_2H_5 \end{matrix}\right\} Zn,$$

and describe any one of them.

VI., V., first set below V., and Second Set, Modern.

1. How much ammonia by weight and volume would be obtained from 20 grams of ammonium chloride? $N=14$, $Cl=35 \cdot 5$.

2. Name and classify the following compounds:—KHO, H_2SO_4, $NaCl$, $ZnSO_4$, $FeCl_2$, HCl, HNO_3, $NaHO$, NH_4HO, and give a general equation showing the action of a metallic oxide on an acid.

3. Explain fully why solution of ammonia is supposed to contain the hydrate of ammonium.

Second Set Classical, Nos. 2 and 3 of the foregoing, and

4. How is ammonia made? Give the equation with weights to formulæ ($Ca=40$).

Third Set below Fifth.

First two questions same as Modern Fourth Set.

3. Put into words:—H_2CO_3, $CaCl_2$, CaO, HCl, $CaCO_3$, $C+O_2=CO_2$.

4. Give the symbols of—calcium, sodium carbonate, potassium nitrate (saltpetre), nitric acid, sulphuric acid.

Third Set Modern.

1. Define the terms acid, salt, base. Write down an equation showing their mutual relation.

2. Classify SO_3, NH_4Cl, H_3PO_4, KHO.

3. The preparation and properties of chloride.

4. Read and give molecular and whole weights of
$2(NH_4)Cl + CaO = CaCl_2 + H_2O + 2NH_3$.

5. How much NH_3 will 160·5 lbs. NH_4Cl give? $H=1$, $N=14$, $Cl=35 \cdot 5$, $Ca=40$.

Fourth Modern Set.

1. How is carbon dioxide (carbonic acid) prepared?

2. How is carbon dioxide distinguished from hydrogen, oxygen, and nitrogen?

3. Put into words,—NH_3, H_2CO_3, $CaCl_2$, H_2SO_4, HNO_3, CaO, NH_4Cl.

4. Put into chemical formulæ—sodium, sodium chloride, sodium carbonate, potassium nitrate (saltpetre), ammonium.

PHYSICS.

VI., V., and 1st Set IVths. } *2, 3, and any two others.*
I. and II. Moderns
2nd Set IVths. *4, 5, 6, and any other.*

1. State the laws of Boyle and Gay Lussac. Are they strictly true in all cases?

2. 20 litres of air are measured off at zero and under a pressure of 760 m.m. of mercury; find the volume of the air (1) when the pressure is reduced to 570 m.m. of mercury, (2) when the temperature is raised to 91°. The co-efficient of expansion for air may be taken as $\frac{1}{273}$ or ·00366.

3. When is a vapour said to be at its maximum tension? Describe some arrangements for determining the maximum tension of aqueous vapour at different temperatures.

4. Describe the different ways in which a body may be changed into a vapour. Show that heat disappears when the change takes place.

5. What circumstances affect the boiling point of a liquid?

6. Give some of the laws of evaporation.

Fourth Modern Set.

1. Give proofs of the pressure of the air.

2. Describe the common barometer, and state how and why it can be used to measure the height of mountains.

3. What is the construction of the common pump? On what does its action depend? What is the greatest length from the lowest valve to the surface of the water in the well, and why? What would the length be if you were pumping mercury?

Third Set below Fifth.

1. How is heat propagated in solids, liquids, and gases?

2. Describe experiments to prove that some bodies conduct heat better than others.

3. Prove that radiant heat is given out equally from all sides of a body, that it travels in straight lines, and is not affected by the air it passes through.

III. Set, Modern.

1. A stone dropped into a well takes 4 seconds falling; how deep is the well, and with what velocity does the stone strike the water?

2. How is work measured? Define horse-power. Of how many horse-power is an engine which lifts 90,000 lbs. to a height of 66 feet in 15 minutes?

3. Describe and draw the three kinds of levers, giving a familiar example of each kind.

4. (*a*) In the 1st kind of lever, if the power is 15 lbs., power arm 8 in., weight arm 3 in., find the weight.

(*b*) If the lever is 1 ft. 4 in. long, the power 4 lbs., and weight 12 lbs., where must the fulcrum be placed?

INTERMEDIATE EXAMINATION.—December 1st, 1873.

CHEMISTRY.

First Modern. Any four questions.

1. C is tetratomic. Show that no compound of C and H can contain more H than is represented by the formula $C_nH_{2n}+_2$.

2. Let $C_nH_{2n}+_2O$ be the formula of a primary alcohol Write the formula of the corresponding aldehyd and acid.

3. Complete these equations, with name to each formula:—

$$N\left\{\begin{matrix}C_2H_5\\ CO\end{matrix} + 2\begin{matrix}K\\ H\end{matrix}\right\}O =$$
$$C_2H_5I + NH_3 =$$
$$C_2H_5NH_2HI + KHO =$$

4. Describe the preparation and properties of acetic acid, with equation.

5. How is ethylene obtained? How may it be converted into common alcohol. Give the formulæ of glycollic and oxalic acids.

VI.—V., and First Set below V.

Second Set Modern.

1. How many pounds of chlorine can be obtained from 150 lbs. of common salt? Na = 23.

2. Write down the weights and volumes represented by these formulæ:—Cl, Cl_2, HCl, H_2O, NH_3, O, assuming that H stands for 1 litre of hydrogen, weighing, 1 crith (·0896 gram.).

3. Why does chlorine bleach?

Second Set below Fifth.

1. How is chlorine made? To what uses is it applied?

2. Complete these equations, with weights and names to each formula. (Mn = 55.)

$$NaCl + H_2SO_4 =$$
$$2NaCl + H_2SO_4 =$$
$$2NaCl + 2H_2SO_4 + MnO_2 =$$
$$MnO_2 + 4HCl =$$

Fourth Set Modern and Third Set below Fifth.

1. What takes place when sulphur is heated till it boils?

2. What are the properties of sulphurdi-oxide?

3. Put into words:—Na_2SO_4, $NaCl$, FeS, $FeSO_4$, SO_2, $S + O_2 = SO_2$, $KI + Cl = KCl + I$.

4. Give symbols of chlorine, bromine, iodine, fluorine; and formulæ of copper sulphide, calcium sulphate, silver chloride, potassium oxide.

III. Modern.

1. Preparation and properties of hydrochloric acid.

2. $CaF_2 + H_2SO_4 = CaSO_4 + 2HF$: Read and give weights and classify.

3. How much CaF_2 will give 100 lbs. HF.?

4. From what sources are bromine and iodine obtained? Give properties of iodine.

5. Name $HClO$, $HClO_2$, $HClO_3$, $HClO_4$.

PHYSICS.

VI., V., First Set IVth. } *any four of first six.*
First and Second Mod.
Second Set IVth., 7, 8, and any two others.

1. Describe Daniell's hygrometer, and the method of using it. What are its defects, and how have they been remedied?

2. Give an account of the spheroidal state.

3. Give the laws of fusion. Why does a mixture of salt and pounded ice produce cold?

4. Define the specific heat of a substance—6 lbs. of boron at 100 are mixed with 1 lb. of water at 10, the specific heat of the boron is ¼; what will be the temperature of the mixture?

5. Describe Bunsen's ice calorimeter.

6. Describe some experiment to show that the specific heat of different bodies varies.

7. Mention some good and some bad conductors of heat. What are the uses of bad conductors?

8. How may you tell which of two bars of metal is the better conductor? What is a safety lamp?

Fourth Modern, and Third Set below V.

Any three questions (but not more).

1. Two tin vessels—one of which has the outside dull and black and the other polished and bright—are filled with cold water, and exposed to the same amount of heat: in which will the water sooner become hot, and why?

2. What effect has pressure on the boiling-point of a liquid? How and why can the height of a mountain be found from the boiling-point of water?

3. Prove that heat can be reflected.

4. What is meant by the spheroidal state of liquids? Give instances.

5. What are the sources of heat—mechanical, chemical, and physical?

6. Describe how heat can be converted into work.

Third Set, Modern.

1. Describe the three systems of pulleys, and find the weight supported by a power of 10 lbs. when there are three pulleys of which the weight is neglected.

2. Explain the principle of the screw. Give the relation of power to weight. If the circumference of the circle described by the power is 5 ft., and the power is 3 lbs., and the distance between the threads is 1 in., find the pressure or weight.

3. The height of an inclined plane is 3 inches, its length 18 inches, the weight is 24 lbs.: find the power acting along the plane.

4. Explain the action of the pendulum. Mention the principal laws. What is the length of the pendulum which vibrates once in 3 seconds?

TERMINAL EXAMINATION.—Christmas, 1873.

CHEMISTRY.

First Set Modern.

1. Describe the process for the determination of the amount of carbon and hydrogen in an organic compound free from nitrogen. What precaution must be taken if nitrogen is also present?

2. A volatile organic compound contains—

C 78·94 }
H 10·53 } in 100 parts.
O 10·53 }

Find the simplest formula, and explain how you would correct this by referring to the specific gravity of the vapour.

3. What are homologous series? Give one or more examples.

4. Distinguish between metameric and polymeric compounds, and give an instance of each.

5. Give the formulæ of common alcohol, aldehyd, and acetic acid, and describe the production of one of them.

6. Give the formulæ of ethylamine and acetamide, and describe the properties of the former.

7. Describe starch, and give its formula and chemical re-actions.

Sixth and Fifth and First Set of Fourths. Second Set Modern, also Woolwich Set.

1. Describe the method of preparing nitric acid, and give equation.

2. What is the result of acting upon sulphuric acid with (1) zinc, (2) copper oxide? Give equations.

3. Describe the action of heat upon ammonium nitrite and ammonium nitrate. Give equations.

4. The preparation and properties of chlorine gas.
Why does chlorine bleach?

5. How much ammonium chloride (NH_4Cl) will furnish 100 grams ammonia (NH_3)?
What will be the volume of the ammonia formed?

(1 litre of hydrogen = ·0896 gram.)

6. Write out in words and give molecular weights of :—

$$3\,Cu + 8HNO_3 = 3Cu(NO_3)_2 + 2NO + 4H_2O.$$

How much $Cu(NO_3)_2$ could be obtained from 254 gram. of Cu, by the above equation (Cu = 63·5).

7. How do you classify the oxides?

Classify H_2O, MnO_2, $Ca(HO)_2$, $KHSO_4$, $CaCl_2$, NH_4HO, N_2O_3.

Write down three anhydrides and the corresponding acids.

8. Name and give the formulæ of the ammonium, sodium, and calcium salts of $HClO_3$, HNO_3, H_2SO_4.

Second Set Fourths.

1. How many compounds does oxygen form with nitrogen? Give their respective names and formulæ.

2. From which of these oxides may nitrous acid and nitric acid be prepared?

3. Give an account of the preparation of nitric acid from sodium nitrate. Equation.

4. Complete the following equations :—

$CuO+2HNO_3=$
$Zn+H_2SO_4=$
$ZnO+H_2SO_4=$
$3\,Cu+6HNO_3+2HNO_3=$
$MnO_2+4HCl=$

5. Give the formulæ of ammonia and ammonium. How is ammonia made? Equation.

6. How may chlorine be obtained from common salt? Why can it not be collected over mercury or water?

7. Give the process for the preparation of hydrochloric acid from common salt, with equation.

Third Set Modern.

Answer questions 1, 2, 4, and 6 of those given above to Second Set Modern; also the following:

A State some of the reasons for saying that the characters of bromine are intermediate between those of chlorine and iodine.

B Give the formulæ and composition, both by weight and volume, of hydrochloric and hydrofluoric acids.

C Complete the following equations, with name to each substance :—

$CaO+2HCl=$
$NaHO+HCl=$
$2KI+Cl_2=$
$2KHO+Cl_2=$
$6KHO+3Cl_2=$

Third Set Classical and Fourth Set Modern.

1. Name the two chief constituents of the air and the proportion in which they are mixed. How is that proportion influenced by the burning of a fire or the breathing of an animal?

2. Describe the pneumatic trough and its uses. Why may oxygen and hydrogen—but not chlorine—be collected in the pneumatic trough?

3. Give the symbols and atomic weights of carbon, nitrogen, oxygen, and sulphur, and name these bodies :—H_2O SO_2, NH_3, HNO_3, H_2SO_4.

4. Define an acid, and give an example.

5. Describe the gas which is given off in this reaction :—

$$2NH_4Cl + CaO = 2NH_3 + CaCl_2 + H_2O.$$

6. Classify these oxides :—CO_2, Fe_2O_3, MnO_2, SO , Na_2O, CaO.

7. Describe chlorine.

8. How may carbon dioxide be prepared? What tests may be used for a carbonate?

PHYSICS.

VI., V., First Set of Fourths.

First and Second Sets Modern.

1. Describe what occurs when water at 0°C is gradually heated to about 8°C.

2. What precautions must be taken in using a thermometer for determining the boiling point of a liquid?

3. Amongst solid bodies which are the best conductors? Give some instances showing that gases are almost destitute of conducting power.

4. 100 cubic inches of air are measured at 0° and 760 m. m. pressure. What would be the volume at 15°C and 749 m. m.?

5. Describe some good way of ventilating a room.

6. Equal weights of mercury and water are exposed over the same source of heat. Which of the two will have the higher temperature at the end of, say, ten minutes, and why?

7. State the law of Dulong and Petit. What circumstances influence the results in determining the specific heat of a series of solids?

8. Under what circumstances is a vapour at its maximum tension? How may the tension of a vapour be determined?

9. Describe some form of calorimeter, and the method of using it.

Second Set below Fifth.

1. How is a mercurial thermometer made and graduated?

2. Express 4°C. on Fahrenheit's scale; and 100° F. on the centigrade scale.

3. Describe some form of compensating pendulum.

4. What sort of bodies are the best conductors of heat? Give three examples each of good and bad couductors among solid bodies.

5. What is meant by "convection?" Explain the trade-winds.

6. Why is mercury better suited for filling a thermometer than either alcohol or water?

7. What is meant by latent heat? when ether is dropped upon the bulb of a thermometer the mercury sinks. Why? Explain this fully.

III. Set below V. Classical.

1. How do you know that heat is not matter? What do you believe it to be?

2. How would you fill a thermometer with mercury?

3. How do you know that a bar of metal expands? Mention instances where the expansion has to be allowed for.

4. Explain the meaning of the term specific heat. What substance has a great specific heat?

5. What is latent heat? What would happen if the latent heat of water was very small?

6. Prove that boiling point of water depends on the pressure. What would you do if you were at the top of a high mountain, and wanted water at 100°C.?

7. Distinguish between conduction and convection, giving experiments to show what you mean by each.

8. What are some of the uses of bad conductors?

9. Will coffee keep hot longer in a bright or blackened pot? Give reasons for your answer.

10. Describe the different ways in which heat can be produced.

IV. Classical.

1. Explain what you mean by mass, motion, velocity. What do you mean by the velocity at any given moment of a train coming to a station?

2. Define force, and use your definition to prove that force is exerted,—

(i.) When a cricketer plays a ball.
(ii.) When a boy falls down.
(iii.) When a goal is tried for.

3. Give an account of the force of cohesion, and point out how it differs from the force of gravity.

4. How can you find the centre of gravity of a sheet of iron? Where would its c.g. be if it were (1) round, (2) square?

5. Define solids, liquids, and gases.

6. Prove that water presses in all directions, and draw and fully describe Bramah's press.

7. What loss of weight does a solid suffer when weighed in a liquid?

A cylinder of wood, 1 foot long, of sp. g. ·75, floats upright in water. How many inches will be out of the water?

8. What do you understand by the phrases porosity, impenetrability of matter?

III. Modern.

1. Define velocity, momentum, force. In what two ways can forces be measured?

2. Explain the phrase impenetrability of matter. How is it that mercury can be forced through a piece of cane.

3. What three things must be given to tell you all about a force? Show that forces may be represented by straight lines.

4. Two forces of 6 and 8 lbs. act upon a particle at right angles to each other. Find the position and magnitude of their resultant.

5. What space will a body falling from rest have travelled over in four seconds? What will be its velocity at the end of the fourth second?

6. How is work measured? Is any work done by a heavy body moving with uniform velocity over a perfectly smooth and flat table. What is the use of machines?

7. Draw and describe the three kinds of levers, and give practical instances of each of them.

8. A nut can resist a force of 4 lbs. only, and I compress with a force of 3 lbs. the ends of a pair of nut crackers 6 inches long. What distance from my hand must the nut be placed so as just to crack?

9. Draw the three systems of pullies you have seen. If in the first system there are 3 pullies, what weight will be supported by a power of 3 lbs.?

10. What is the law of attraction discovered by Newton?

Fourth Set. Modern.

1. "Liquids find their level." Explain this.

2. Explain the fact that when a body is plunged into a liquid it loses weight. How much weight does it lose?

3. A small bottle is capable of holding 120 grains of water; another of exactly the same size will hold 1,620 grains of mercury. Find the specific gravity of the mercury.

4. Describe the common barometer. If the tube were made twice as wide in the bore would that alter the height of the mercury?

5. Describe some experiment to show that bodies expand differently when heated. Is this true of all bodies?

6. What is meant by convection?

7. If a red hot ball is supported on an iron tripod, mention the different ways in which it may lose its heat.

---

§ 9.—MOST EFFECTIVE FORM OF LESSON.

As to the form of lesson which is found to be most effective, the Head Masters of Taunton College School and Rossall School consider practical work unquestionably to be so. The former says, for senior boys, "We aim at extending it in all subjects as our means and our teaching power increase; but for junior boys, oral teaching and demonstration, accompanied by *frequent examinations*, are for some time almost exclusively necessary." Similarly, the Head Master of Rossall writes that, next to practical work, "the oral teaching, when accompanied by, and based upon, constant repetition and examination" is the most valuable.

At University College School, experience proves that practical lessons are "the best form, the only true form; though much less ground is got over by this method, yet the knowledge thus acquired is at once more valuable and more lasting." "The best—indeed only thoroughly satisfactory—results are found to follow in the case of those boys who have not depended on books at all, but solely on the oral lessons and demonstrations. Oral teaching and demonstration are, indeed, far more effective than unaided practical work, hence their fusion [at this school] in the class of practical chemistry." "Book-work has been tried as an experiment but with signal failure; it would undoubtedly be the most effective form of lesson, if external examiners were employed, unless, perhaps, the examinations were carried on *vivâ voce* before the Science masters."

The Teacher of Physics at the Manchester Grammar School says, "I find the 'Socratic' form of lesson the most efficient. In this form of lesson the information required to be taught is either educed or built up by series of logical questions systematically put to the boys, not on what they have acquired verbally from the book or the teacher, but put to them on the apparatus, the experiments, or the phenomena, or problems as they are actually before them. In this way the observing and reasoning processes, and those of scientific and literary exposition, are cultivated simultaneously."

The Science Master at Harrow says, "As far as it has been attempted, a lesson in which the boys are made to repeat experiments which they have seen performed by the teacher at a previous lesson, or other simple experiments, is found to be by far the most effective."

Mr. Madan, Assistant Master at Eton, says, "It is not quite easy to compare the oral instruction with the practical work. The latter is strictly supplementary to the former, and serves to fix in the mind what has been previously shown. It is doubtful whether practical work by itself is sufficient. Without previous oral teaching, a boy is apt to do an experiment mechanically, without realising its full meaning. During laboratory work, the boys are advised to consult their text-books and note books, and constant reference is made to what has been shown in lecture."

In the opinion of the Head Master of Rugby the best form is a combination of catechetical lecture and lesson, the boys themselves being often encouraged to ask questions upon any points not clearly understood. And the Head Master of Marlborough College considers lectures to be most effective, so long as they are of such interest that the attention of the boys is well maintained upon the subject which is being taught.

The Master of Dulwich College says, "No one of them can be dispensed with, without impairing the efficiency of the entire system of instruction."

The Head Master of Clifton College remarks that "in teaching boys of ordinary ability who possess but little knowledge, it is necessary, in the first place, to lecture a good deal and to impress important facts, principles, and methods as distinctly as possible by illustrative experiments. Without such help, owing to the great want of imagination, many boys would not discover their own tastes, and such conceptions as they might derive from their reading or catechetical lessons would be extremely confused and indistinct; besides that, good lectures greatly facilitate the progress even of those boys. On the other hand, however, it is at least equally necessary to guard against the passive attitude of the learner who is merely or chiefly a listener to lectures. Thus, a good lecturer will always take great pains to keep his class alive by means of test questions, or by insisting on well-written notes, or such other method as may be most conveniently applied. A good deal of the scientific instruction which has hitherto been given in schools has failed, comparatively, as a means of educational training, simply from the fact of the teacher or lecturer having allowed the boys to be too exclusively passive and receptive."

The Head Master of Cheltenham College writes, "Speaking generally, the combination of oral teaching and demonstration with book-work and practical work is more effective than either oral teaching and demonstration, or book-work, or practical work *alone*; but much depends on the nature of the subject and the character or genius of the teachers; and when diverse forms are used as supplementary to each other, it is impossible to contrast their efficiency."

The Head Master of the City of London School says: "I am of the opinion that a combination of oral teaching with demonstration, book-work, and practical work will be found the most effective form of lesson, but I am unable to form a comparison, as in no division of this school is the teaching exclusively confined to any one form. The class for practical chemistry, of course, shows to the greatest advantage, as it is composed of the most advanced boys from each of the upper divisions."

The Head Master of King's College School considers the best form to be "where the oral teaching of the lecturer is followed by the use of the text-book."

The Head Master of Wellington College is of opinion that oral teaching accompanied by experiments will be the best mode, at least as compared with book-work.

And the Head Master of Christ's Hospital says, "There is no doubt that in all cases oral teaching by a good teacher is far more effective than any book can be."

Use of Note Books.

It will be seen from the replies to question 13, that although note books are generally employed for oral demonstrations, the way in which they are used (*i.e.* during or after the lecture), examined, and marked, varies considerably. In almost all the schools I have visited I have inspected some note books taken at random, and it has not been difficult to see that the best teaching and the best kept note books were closely associated. There is abundant evidence that a boy of average ability can, if he chooses, expand his rough notes into a tolerably connected and methodical account of the lecture he has just heard, illustrate it with copies of some of the more important diagrams, and accurate descriptions of experiments or objects which have been placed before him. I have seen such expanded notes made by boys of 10, who were learning botany, notes which were models of method and clearness, while each flower placed before them had been drawn and coloured wonderfully well, and all its parts named on the margin of the notes. This is almost an education in itself: a habit of mental tidiness flows from it as readily as a habit of general tidiness flows from good laboratory work; and although such carefully expanded notes entail much labour on the teacher, it will doubtless become, in time, to be considered as among the most important work, and good notes will be encouraged by higher marking than they always receive at present.

A strong argument against *full* notes being taken during the lecture is thus stated by the Teacher of Physics in the Manchester Grammar School. He says:

"My own experience has shown me that, in scientific teaching, where mere memory is the least important active faculty, but where the activity of the observing, reasoning, constructive, and investigating powers is continuously required, the mental condition essential to the taking of full notes is inconsistent with the real scientific progress which should be made during the course of any really well-reasoned out and demonstrated scientific lesson; the notes made after the lesson cannot, however, be too full or complete."

---

§ 10.—ALTERNATIVE SUBJECTS.

The subjects are fixed at Eton College, Winchester College, Cheltenham College, Taunton College School, Charterhouse School, King's College School (except in very special cases), and the City of London School. At the Manchester Grammar School, though in the scientific forms the scientific subjects are fixed, there are voluntary classes for chemistry, mechanics, and physical geography, any or all of which a boy may attend at his pleasure.

At Rugby as much elasticity as possible is given to the whole system of Natural Science work in the school, so as to enable a boy to take the subject he has the greatest desire to learn, as, for example, in the selection of chemistry, heat, or electricity, in the upper school. At Clifton College the rule is to make all boys in any particular part of the school do the subject prescribed for that division; though it has happened, in a few cases, that boys have been allowed to take up physiology instead of physics, or, when preparing for a government examination, to confine their attention for a little while to the subjects required.

It is most important to add here that in the higher part of the school, a boy who shows ability is allowed to drop verses, together with a certain amount of general classical work, and devote the extra time to Mathematics or Natural Science. By so doing he does not lower his position in the school or lessen his chance of future promotion, as he receives a full equivalent of marks for actual work.

At Marlborough College, in the fifth forms, a boy may choose between verses, history, and science, and in the upper shell and upper fourth (A and B) forms, a boy may choose between verses, history, and French, and a second non-compulsory hour of science work.

At Wellington College, the boys in the classical school may learn drawing instead of science; only 4 out of 29 do so, the other 25 choose science, though much harder work and involving great trouble in writing out notes. In the Mathematical School at this College there is a choice between Greek and science, and science is chosen in about five cases out of six. No choice is allowed between different departments of science.

At Christ's Hospital boys who are preparing for a special career or examination are often allowed to drop a large part of their classical work, and devote the time to special branches of mathematics or science; thus, at present, two boys, who are preparing for Cooper's Hill College, have given up Latin and Greek composition, and study light, heat, &c.

At Dulwich College, the science subjects are grouped as follows:—

I. Chemistry, with laboratory work.
II. Physics (at present electricity and magnetism) - } alternative subjects taught at the same time by different masters.
Geology - - - - }
III. Physical geography.

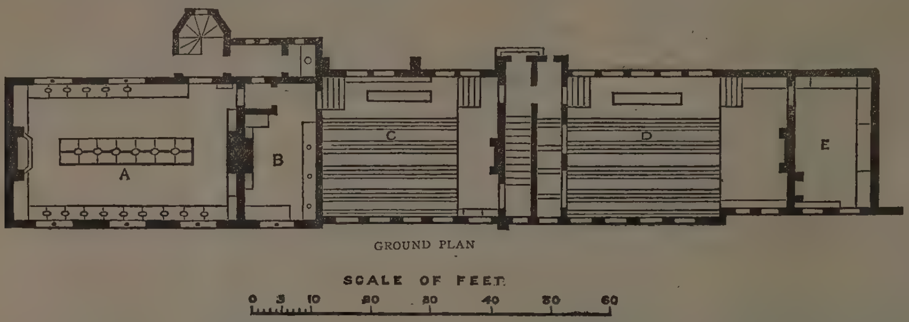
Boys have the opportunity of receiving instruction in one or more of these groups.

---

§ 11. CHEMICAL AND PHYSICAL LABORATORIES.

RUGBY.

The accompanying ground plan will give a general idea of the arrangements adopted in the Chemical Laboratory at Rugby (there is no Physical Laboratory), and of its connexion with the Chemical and Physical Class Rooms, the Natural Science Schools being only part of an extensive block of new buildings containing several classical and other schools.



A. Chemical Laboratory.
B. Private Laboratory.
C. Chemical Lecture Theatre.
D. Physical Science Lecture Theatre.
E. Work Room and Apparatus Room.

As will be seen from the plan, the laboratory is 35 ft. by 22, and can accommodate thirty boys. It was formerly the only Natural Science lecture-room; but it has been entirely refitted, in order to convert it into a laboratory, to replace B, which was the room formerly used for this purpose.

The following account of the detailed arrangements have been derived from information which the Rev. T. N. Hutchinson has been good enough to supply.

The working tables are divided into compartments, seven on each side of the centre table, and ten and six in those along the sides of the room. Each compartment comprises a cupboard and two drawers, two shelves for bottles containing the ordinary reagents used in analysis, two gas taps, waste basin with water supply, and a working space of 3 ft. 6 in. by 1 ft. 9 in. As there are often between 40 and 50 boys using the laboratory in a term, the same compartment is frequently assigned to two boys, who share the drawers and cupboard, &c., between them; it being arranged that the boys shall not have their laboratory lessons at the same hour. Each cupboard contains 1 retort stand with wire gauze and sand bath, 1 flask, 2 funnels and funnel stand, 2 evaporating basins, nest of small beakers, test tubes and rack, wash bottle, and two blocks of wood for supports.

In the drawers are a blow pipe, iron tongs, 2 watch glasses, test tube holder, glass rods, and tubes.

All other apparatus, such as retorts, deflagrating jars and spoons, gas bottles, &c., is used in common, and is given out to each boy as he requires it. The water taps and basins in the central table are placed so as to serve for boys working on either side, and thus much space is gained. The water taps have a small orifice, and are specially adapted for filling test tubes. A water pipe is also carried along the highest shelf, and there are taps at intervals for filling tall vessels, for working with Liebig's condenser, &c.

The sink, with arrangements for washing and drying bottles, is seen near the door in the drawing.

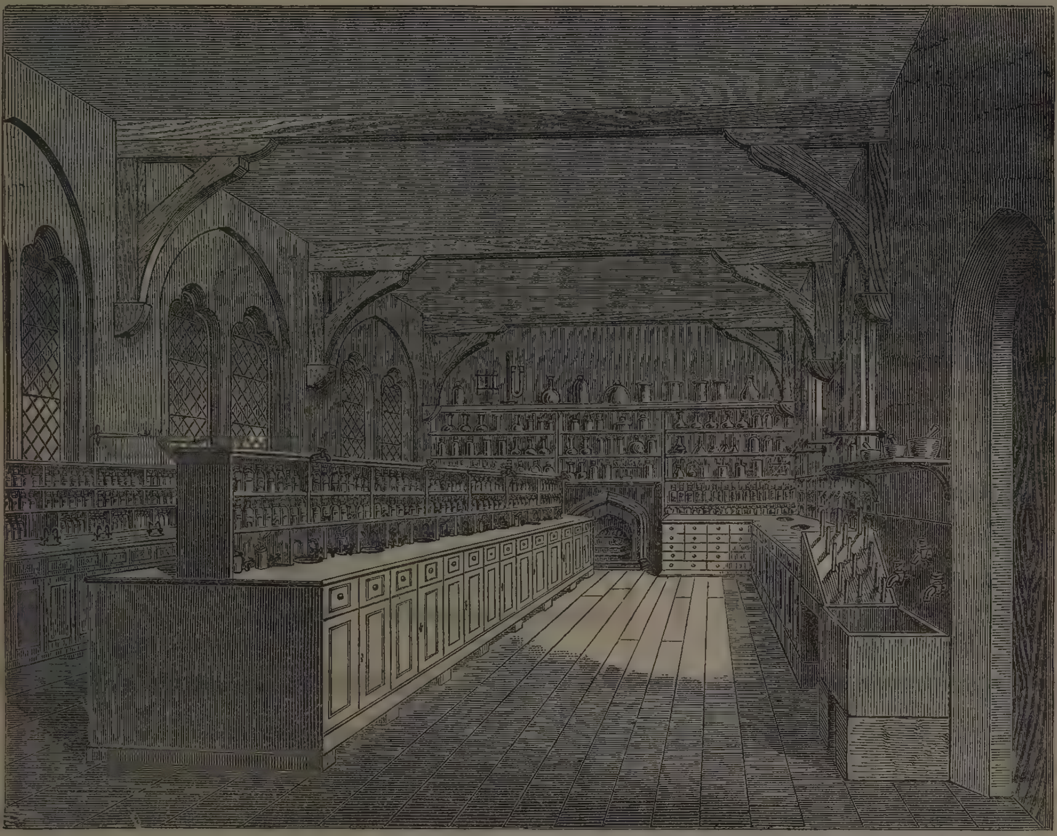
At one end of the room is an open fireplace, with shelves and nests of drawers on either side. The drawers contain the various articles that are in general use in the laboratory, such as corks, cork-borers, elastic tubing, holders of different kinds, glass tubes and rods, &c.

The lower shelves above the drawers contain all the dry chemicals required in Harcourt and Madan's "Practical Chemistry" (the book chiefly used in the laboratory), together with the more costly reagents, and others that are in less frequent use. Each boy, as before stated, has a complete set of all the ordinary acids and test solutions on the shelves of his compartment.

The contents of the drawers and shelves on either side of the fireplace are arranged in duplicate—a complete set on each side. In this way all chance of confusion and crowding is avoided, as no boy can have occasion to cross over from the side of the room on which he is working to the opposite side, everything being ready to his hand.

A common balance with sets of gramme weights is placed on the table above each nest of drawers. Here also are kept the various measuring flasks and cylinders. At the other end of the room is an ordinary six-feet kitchen range, which has been slightly modified so as to serve for a furnace. It has sand-bath, boiler, and drying-oven. On one side of the furnace is a cupboard to contain a stock of glass and porcelain apparatus. On the other side are two spacious evaporating closets with sliding glass doors. These are supplied with hoods and jets for creating a powerful draught. The draught can be still further increased, when necessary, by lighting a large ring of jets in the flue communicating with the closets.

A small cupboard for tools and a glass blower's table complete the furniture of the laboratory.



General View of Laboratory.

The room marked B, in the ground plan, was formerly the only laboratory for the use of the school. It was built some years ago, at the same time as the Natural Science lecture-room, and, though small, was exceedingly well arranged. It is now converted into a private laboratory for the use of the chemical lecturer. It contains a large evaporating closet, also a sand-bath and distilling apparatus, both of which are worked by the fire in the school laboratory by means of appropriate dampers. Here also is the flue for obtaining a down-draught at the lecture-table in the adjoining chemical lecture theatre. As several pipes open into this flue, it was found necessary to place the large ring of gas-jets for creating the draught at a considerable elevation above the floor. To light this ring an artifice was employed that it may be worth while to mention. A supplementary gas-pipe was carried alongside of the supply-pipe from a few feet above the floor to the ring of jets. This was pierced with small jets at short intervals all the way to the top. A separate tap turns on the gas in this pipe, and upon applying a light to the lowest jet the flame runs rapidly up the pipe and lights the ring at the top. The gas is then turned off from the supplementary pipe and the ring alone left burning.

From the private laboratory a door opens into the chemical lecture-room. This is provided with seats for 50 boys, the forms and desks rising tier above tier, so that experiments at the lecture table are well seen by all. The down draught at the lecture table, already alluded to, is most useful. Experiments with chlorine may be performed with hardly any smell escaping.

The theatre is well supplied with shelves, cupboards, apparatus cases, diagram-screens, and black-board. There is also a capital cellar for stock chemicals, batteries, and empty cases.

The laboratory instruction is given by the senior Natural Science Master and a qualified assistant. As the boys are allowed to come to the laboratory at such times as fall in best with their other work, there are few hours in the day when there are not at least two or three there; occasionally as many as 14 or 15 are at work at the same time; but as boys require much individual attention, a larger number than this is not thought desirable.

Under ordinary circumstances each boy has two lessons week, of rather over an hour's duration.

The laboratory is used by three classes of boys:—

(1.) By those whose parents wish them to obtain a knowledge of practical chemistry in addition to all their other work. These boys become the private pupils of the senior Natural Science Master, and pay an extra 10 guineas per annum. The number is at present limited to 30.

(2.) By boys who have been so long in the school that they have gone through all the ordinary Natural Science courses of lessons. Such boys, instead of recommencing a subject, are allowed, if they wish, to attend the laboratory at the times when they would otherwise be at a Natural Science lesson. In some cases, however, they have preferred to go through one of the courses a second time, often with very satisfactory results.

(3.) By boys who have been allowed to join the laboratory as a reward for special industry and success in one of the regular Natural Science courses.

The plan of practical work pursued is as follows:—A boy at first begins with Harcourt and Madan's *Practical Chemistry*. He performs all the experiments himself, constructing and building up his own apparatus with such assistance as he may require. After the ordinary elementary manipulation with gases, distilling, &c., he studies the properties of the different classes of salts, metals, and acid radicles, and so is prepared for the converse process, in actual analysis, of determining a substance from observing the properties which he finds it to possess. Then, after working out some 40 or 50 simple salts as exercises in easy qualitative analysis, he proceeds to mixtures more or less complicated, using Fresenius or Galloway.

Very few boys at Rugby have gone beyond this and attempted quantitative analysis. In every case a boy is required to write out a complete account of every step he has taken in each analysis.

Lately the system has been introduced of allowing quite young boys from the Middle School, who have expressed a strong desire to learn practical chemistry, and have a real taste for the subject, to work in the laboratory. Probably their answers, if pressed too closely as to the precise nature of the chemical changes going on in their experiments, might not be very satisfactory. But, for all this, the senior Natural Science Master is clearly of opinion that *they are beginning in the right way*. He states, "They "are getting acquainted with facts and real things, they "see with their own eyes the effects of different classes of "bodies upon each other, and acids, bases, and salts, "become with them something more than mere terms. "Such boys, when, later on, they join a chemical 'set' "in the Upper School, generally take the lead, and prove, "by the greater readiness with which they follow the "lecturer in his theoretical explanations, the advantage "they have gained by commencing chemistry from the "practical side."

In addition to the laboratories (A and B) there is a chemical lecture theatre (C), a physical science theatre (D), and an apparatus room (E).

ETON.

The arrangement of the Chemical Laboratory at Eton is shown in the accompanying ground plan.

As at Rugby, there is no Physical Laboratory.

There are two rooms on the upper floor—

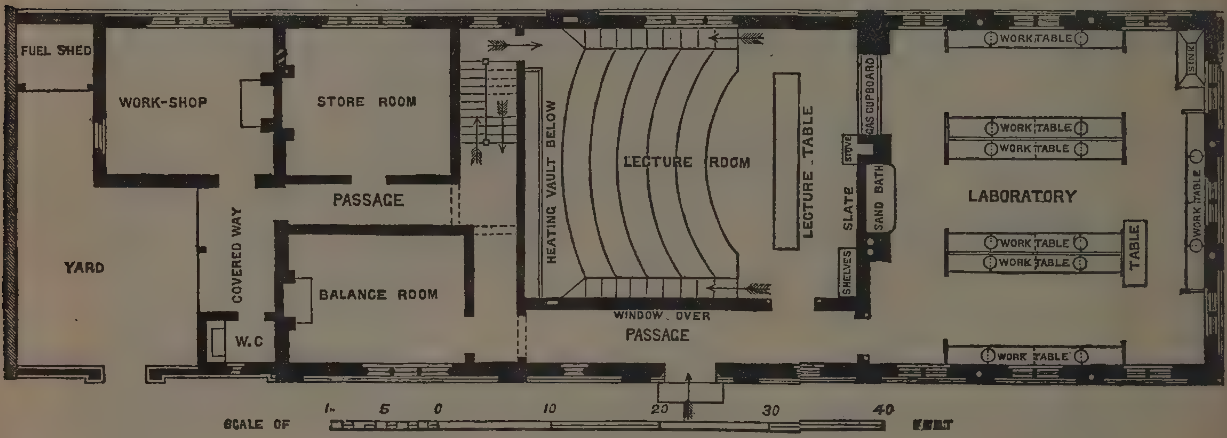
(1.) A private laboratory.
(2.) A sitting room.

The laboratory is most efficiently arranged, and has table accommodation for sets of 28 students.

The walls of the building are of local red brick, with Bath stone dressings; the roofs are covered with brindle-coloured Staffordshire tiles, those of the laboratory and lecture-room being open-timbered. Special attention has been paid to the arrangement and general detail of the fittings, in order to make them as suitable and convenient as possible.

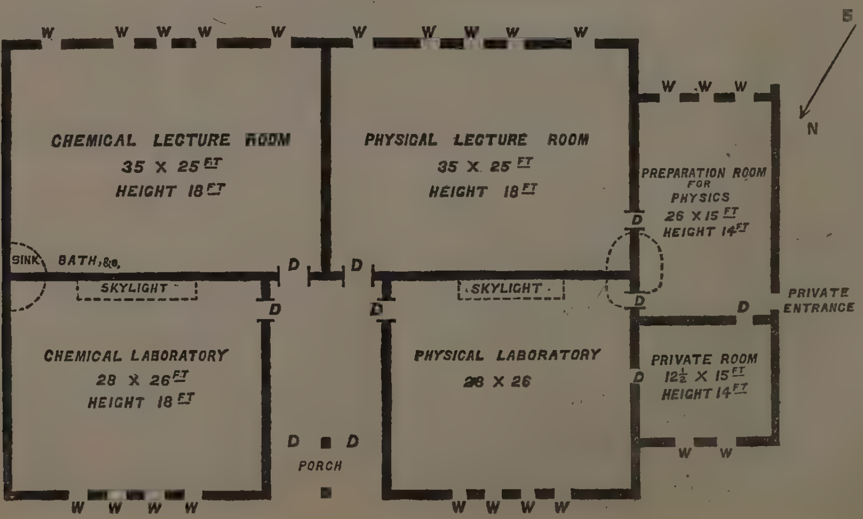
The building is heated by a boiler apparatus in the vault, and hot-water pipes in connexion; the ventilation of both laboratory and lecture-room has been well provided for, and provision is also made, by means of pipes, acted upon by gas jets, for effectually carrying off the noxious fumes and gases.

The cost of the building, inclusive of the fittings, has been about 4,000*l*.



HARROW.

The erection of Chemical and Physical Laboratories and Class Rooms at Harrow is of quite recent date. The proposed arrangements are shown in the accompanying plan.

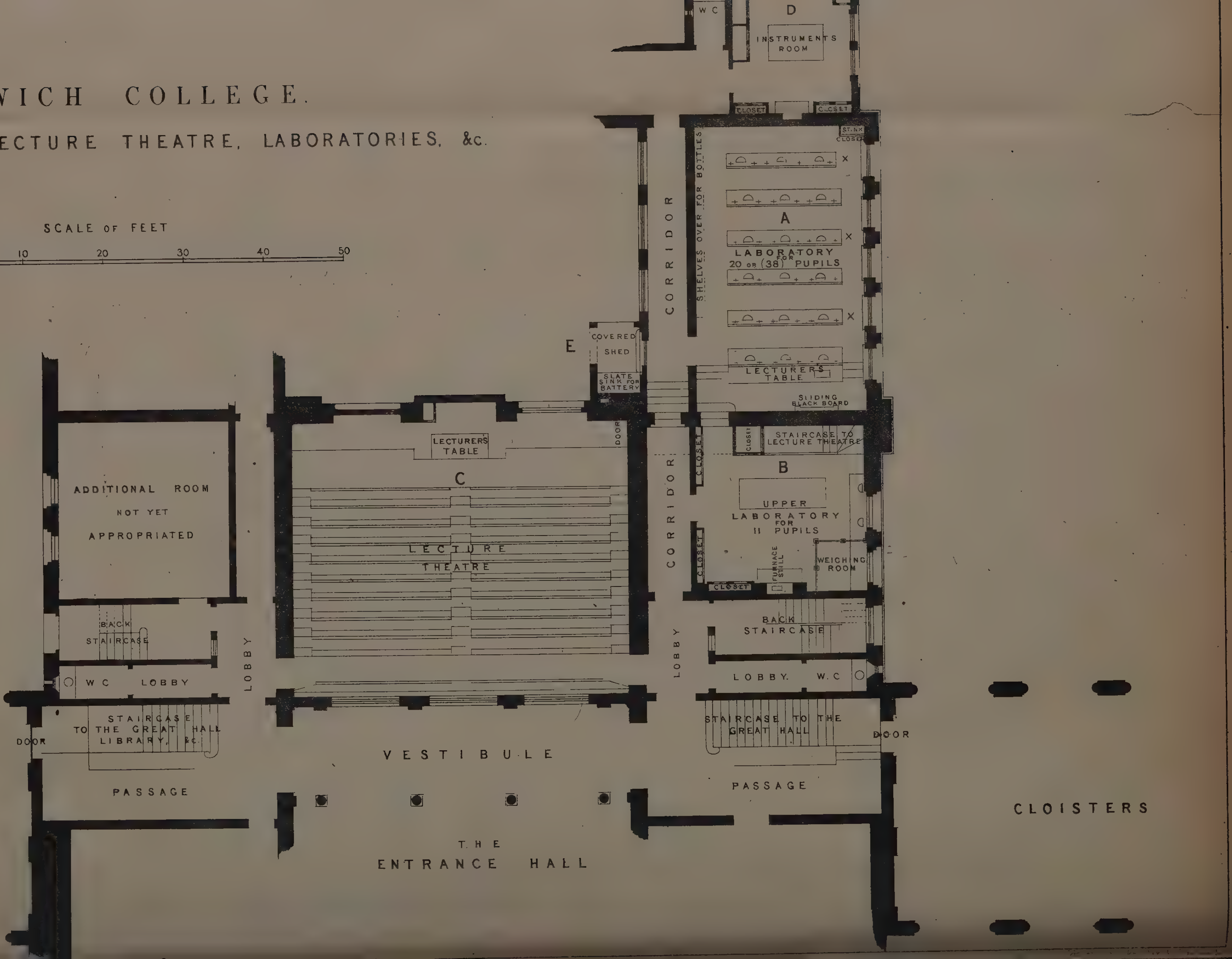


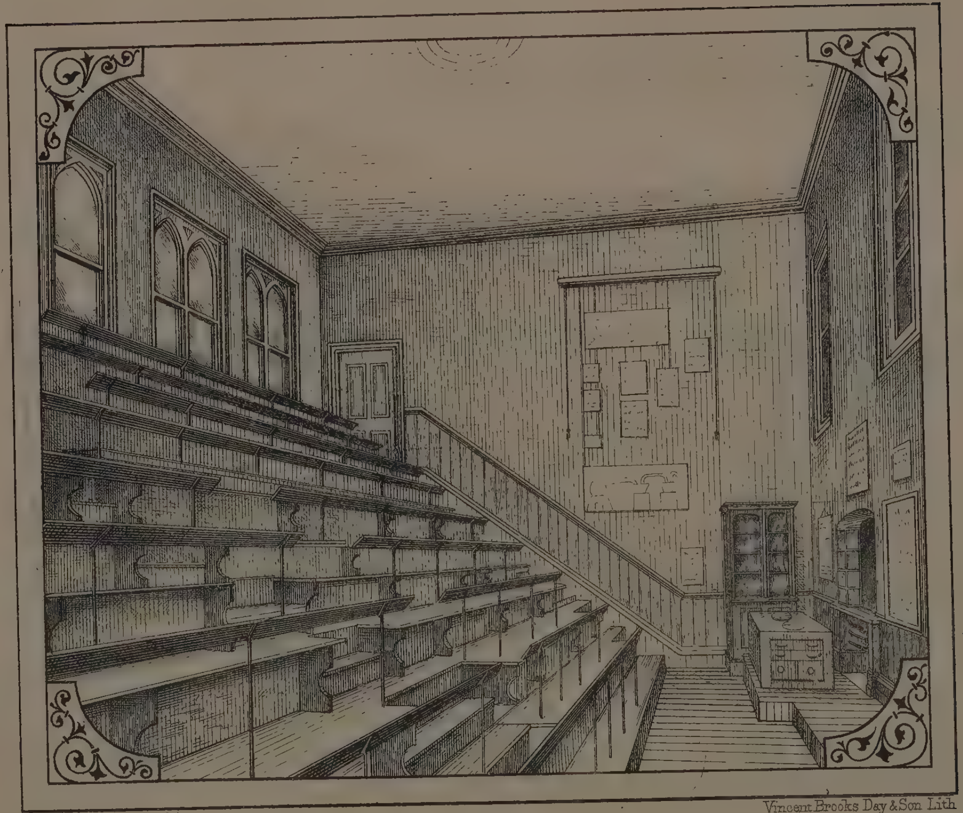
DULWICH COLLEGE.

PLAN SHOWING LECTURE THEATRE, LABORATORIES, &c.

SCALE OF FEET

10 5 0 10 20 30 40 50



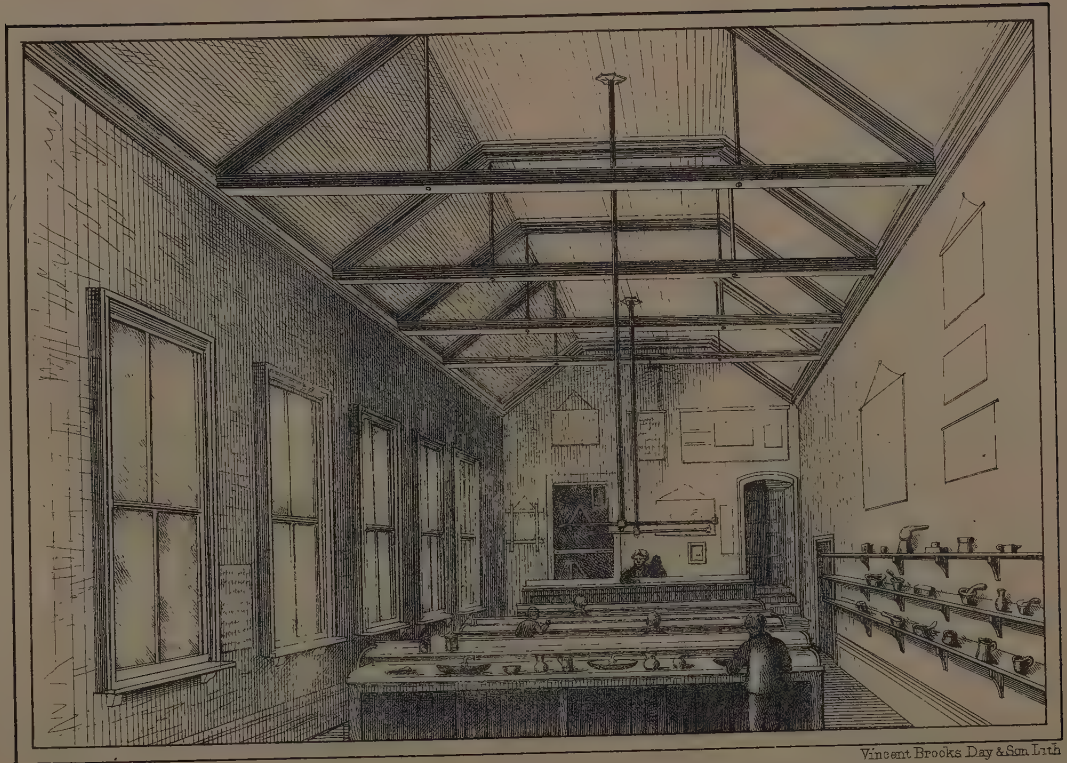


LECTURE THEATRE – DULWICH COLLEGE.

Charles Barry Archᵗ.

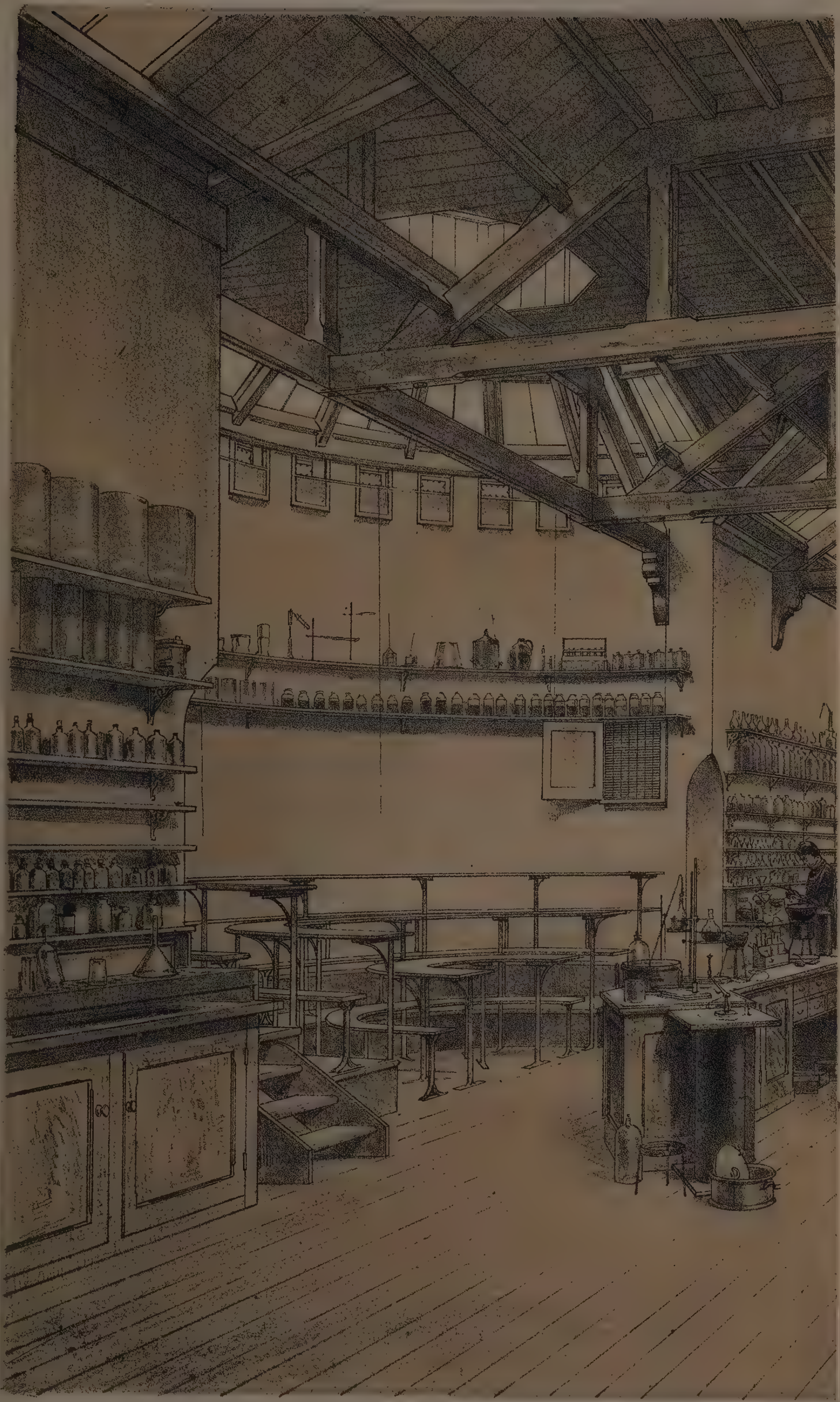
Vincent Brooks Day & Son Lith.

CHEMICAL LABORATORY DULWICH COLLEGE.



Charles Barry Archᵗ.

Vincent Brooks Day & Son Lith



CHEMICAL

UNIVERSITY

LABORATORY

COLLEGE SCHOOL

Below the Chemical Lecture Room there will be a room of the same size (35×25 ft.; height, 12 ft.), which will be used as a room for holding Physiological and Natural History Specimens.

Below the Chemical Laboratory, there will be two small rooms, which will be used, it is hoped, as Work Rooms for Physiology, &c.

The rooms below the Physical Department will be only 10 feet high:—one of these will be used as a Balance Room; another as a small workshop; a third, as the room for supplying hot air to all the buildings; the remainder as store rooms.

The shell of the buildings will cost about 4,800*l*.

DULWICH.

At Dulwich there are two Laboratories—the Lower (or Chemical) Laboratory (A), and the Upper or Small Laboratory (B), shown in the accompanying plan,—thus described in a Statement furnished by the Master.

A. The Lower Laboratory is 36 feet long by 21 feet wide and 16 feet high. At one end is a platform raised 1 foot 7 inches above the floor of the room. On this is placed the Teacher's or Demonstrator's table. The table is provided with a sink and a leaden cistern (which serves as a pneumatic trough), with several Bunsen burners and the various appliances necessary for Chemical Demonstrations. On the wall behind is a large sliding blackboard, so placed as to be in view of all the pupils at the working tables. Three steps at either end of the platform bring the teacher to the floor of the room to inspect the work of the pupils from table to table.

The working tables are arranged parallel to each other, and are so placed that all the pupils face the teacher. Each table is adapted for six pupils. There are a sink and a water-tap between each two, and a Bunsen burner for each separately. In front is a shelf for bottles containing the re-agents ordinarily in use, &c.

In the spaces below the tables—which are divided into compartments, but not closed with doors—each boy keeps the various pieces of his apparatus, retort stands, filter stands, &c.; and also a box with divisions to hold his store of test tubes, elastic tubing, glass rods, &c.

These last are provided at his own expense, and are kept by him under lock and key. Except for apparatus of this kind, which is necessarily treated as personal property, there is no additional expense incurred by a boy joining the Science Classes. The re-agents (as well as the use of all the more expensive apparatus required) are supplied by the College without special fee or extra charge.

There are, at present, in the Chemical Laboratory three working tables, as above described, supplying accommodation for 18 boys. Two more pupils are similarly accommodated at the end of the Teacher's table on the raised platform. Additional accommodation for 18 boys can at any time be provided by the erection of three more tables. These were, in fact, included in the original design (as indicated in the plan and marked with a ×), and gas, water, and drain pipes are already laid for them. It is doubtful, however, whether more than 20 boys can be efficiently taught at one time. The existing accommodation is, at any rate, found sufficient at present, if used by different classes in succession.

The Laboratory is lighted by five large windows on the left of the pupils, and warmed by hot-water pipes. At the further end of the room is an aperture in the wall connected with a flue, and supplied with a powerful Bunsen burner, to carry off noxious vapours and assist in ventilating the room.

B. The Upper Laboratory, 21 feet long by 18 feet wide, is fitted with cases and cupboards for keeping the apparatus for physics and chemistry. It is also used as a Physical Laboratory, and occasionally as a Science Class Room for special instruction. It is provided with a working-table for chemical purposes similarly fitted to those in the Large Laboratory, and giving accommodation to four pupils, and has, in one corner, a large glazed closet for weighing.

D. The small room marked D is at present occupied by the boys' school library, but is intended to be used, when required, as a room for apparatus, and, probably, at the same time, as a private room for the Science Master or Masters.

E. The covered shed or lobby, built out into the open yard, is fitted with a slate slab and sink for the galvanic battery. Wires are carried from it to the Lecturer's table in the theatre, and to the Science Master's table in the Lower Laboratory.

Below the Upper Laboratory and the adjoining corridor is a Basement Laboratory fitted with a furnace for the study of metallurgy, &c.

In the basement is also a workshop with a lathe for wood and metal turning. A skilled artizan (who acts also as engineer and mechanist in the College) is in charge of this workshop, and is able to construct and repair a large part of the less delicate apparatus used in the Science Department.

A separate room, not included in the plans, is used as a class room for instruction in Geology (or Botany). It is one of the ordinary class rooms of the College, well lighted and ventilated, and with ample wall space for diagrams. It will contain from 30 to 36 boys.

C. The Lecture Theatre is 43 feet wide by 35 feet deep. It is fitted with 10 parallel rows of seats, and is capable of accommodating 250 or 260 people. There are narrow desks to each row of seats, adapted for the purpose of taking notes. These desks will accommodate about 220 students. They are supported by strong iron rods, dropping into sockets, and can, therefore, be easily removed when not required.

The Lecturer's table is well supplied with gas burners of various shapes and apertures. It has a sink and a large sunken cistern to serve as a pneumatic trough. Immediately behind the table is a glazed closet, with sliding sash, to carry off noxious and offensive gases.

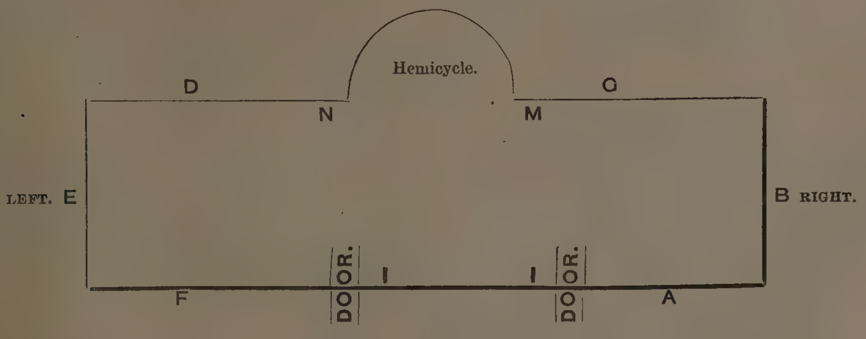
The theatre is lighted by a "sunlight" burner, which also serves to assist in ventilation, and it is warmed by hot-water pipes. A glass cupboard is provided for the storing of apparatus, and the space beneath the lecture table is occupied by drawers for the various necessaries of a lecture room.

The theatre is used (1) for oral instruction and demonstration to the Science classes, and (2) for courses of evening lectures, on Science or Art, given in each term generally by some lecturer not belonging to the College staff. These evening lectures are open to all boys in the College, whether members of the Science Classes or not, but attendance at them is quite voluntary.

UNIVERSITY COLLEGE SCHOOL.

At this School there is a good Chemical Laboratory recently constructed on a plan suggested by Mr. Temple Orme, who has furnished the following account of it.

The General Arrangement is shown in the accompanying sketch. It will be seen that it is at once a Laboratory and a Class Room.



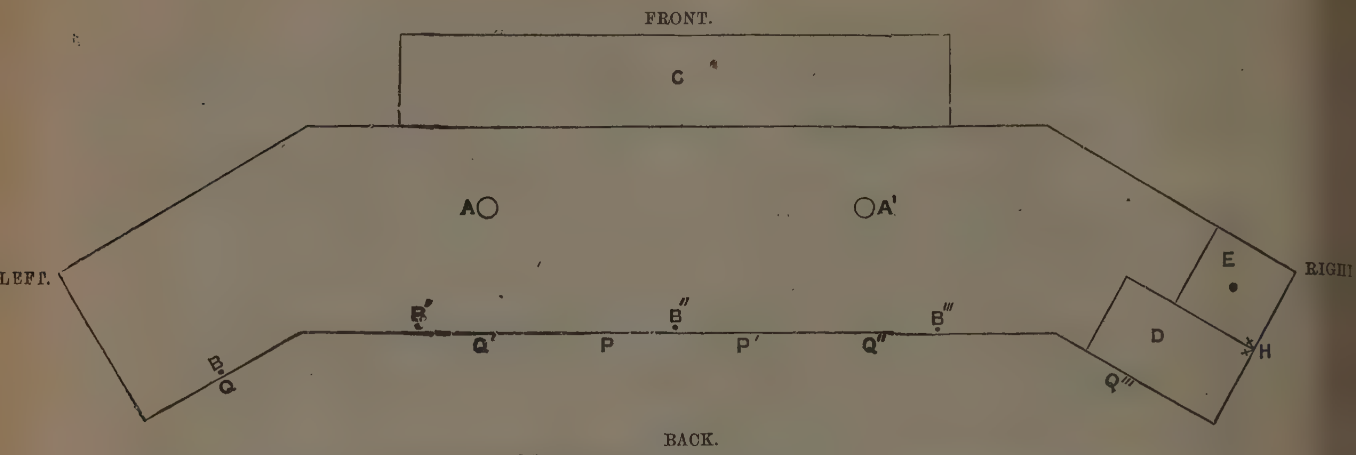
PLAN OF LABORATORY.

1. *Benches and Desks.*—There are three concentric arrangements of benches and desks within the hemicycle. Breadth of benches 9 inches, of desks 12 inches. A space of about 1 foot between each desk and next interior bench, each bench being raised at least 1 foot above the next interior bench.

2. *Lecture Table* (*vide* Sketch):—8 feet long parallel to the diameter of the semicircle, with two returns of 2 feet

each, at an angle of 150° with the main body of the table. Breadth of table 2 feet 3 inches, height 2 feet 8 inches. The top of the table projects about an inch over the face of the cupboards beneath; but there is also a groove along the surface all the way round, ½ an inch from the edge; this groove is about ½ an inch broad and about ⅜ of an inch deep.

2*a*. *Drawers.*—In the centre of the table (P and P′) at least four drawers; if possible, two rows of three each. Each drawer to be about 2 feet long, 1 foot broad, and 3 inches deep.



Plan of Table, half an inch to a foot.

A, A′	Down draughts.
B . . . B‴	Gas-pipes at edge of table.
C	Specimen table.
D	Trough, with waste-pipe.
E	Sink.
H	Taps for water.
P, P′	Position of drawers.
Q . . . Q‴	Cupboards.

2*b*. *Cupboards.*—(Q, Q′, &c.) These occupy the remainder of the space available for that purpose. They are provided with one shelf about 1 foot above bottom of cupboard and coming to within ½ an inch of door; also with two sliding trays, 4 and 8 inches respectively from the top of the cupboard.

2*c*. *Trough* (D.)—In the right-hand return, and at the front of the table, a pneumatic trough constructed of slate; dimensions, 1 foot broad, 1 foot and a half long, 1 foot deep. The interior is quite plain, except that there is a hole with plug at the bottom connected with waste-pipe. There should be a grating just below the plug to prevent stoppage, and a joint within easy reach.

The top edge of the trough (which will be about 1 inch thick) should be a little below the level of the table; and a wooden lid should be provided, which, when placed over the trough, will completely cover it and be flush with the table.

Tap (H) for water supply.

2*d*. *Sink* (E) of glazed stoneware, 1 foot in diameter, placed behind the trough.

Tap (H) for water supply.

2*e*. *Down-draughts* (A, A′) of glazed stoneware, coming out at right hand of furnace, where, on a level with the floor, a small air-tight door is provided, within which is a ring of gas jets; thence passing into the flue of furnace.

2*f*. *Gas Pipes* (B, B′, &c.)—One pair in left-hand return, and three pairs along the central portion. All these being as close as possible to the back edge of the table.

3. *Specimen Table* (C.)—Placed in front of lecture table. Length 6 feet, breadth 1 foot, height 2 feet. The upper surface will be used solely for the display of specimens.

4. *Blow-pipe Table,* placed near the back wall on the left of the still (*q. v.*).

5. *Slate,* on easel.

6. *Work Tables* (26 in number), 3 feet long, 1 foot 9 inches broad, 3 feet high. Upper surface of wood, quite plain, neither painted, paraffined, nor stained, &c.; groove as with lecture table, and projecting 3 inches over the cupboards beneath; there is no partition between any two contiguous desks, since the sinks will be quite sufficient to indicate the limits of each.

6*a*. *Cupboards.*—Beneath each table, a cupboard similar to 2b.; except that there is only one sliding tray 4 inches from top, and there are two shelves, one of which is 1 foot from bottom and the other midway between this and the tray, both coming to within an inch of the door.

6*b*. *Sinks,* 1 foot in diameter, of glazed stoneware; waste pipes of same, with plug, beneath which is grating; joints within easy reach. One sink for every two tables.

6*c*. *Tap,* for water supply; one for each sink.

6*d*. *Gas Pipes.*—One pipe dividing into two smaller ones (one for each table), placed alternately with the sinks. Also near each sink one fish-tail burner for lighting purposes.

6*e*. *Shelves.*—Four in number above each table; strongly fixed to the wall; about 4 inches deep. The first shelf is 1 foot above table, the others are 6 inches apart. The shelves of one table are continuous with those of the adjacent tables, but separated from them by a narrow upright placed against the wall; these uprights may, but need not, come to the front.

7. *Sink* at N., on the *left*-hand side, with tap and arrangements for washing and drying bottles, &c.

8. *Teacher's Work Table* at M, on the *right*-hand side, 5 feet long, 1 foot 9 inches broad, and 3 feet high; cupboards beneath with *revolving* doors and two drawers about 4 inches deep. Desk grooved. Separate sink, tap, and gas supply (two gas pipes in middle, *close to the wall*). Shelves above, the same as with the other tables. This table will be used for the preparation of class experiments.

9. *Shelves* for large apparatus, &c. Against the wall and extending, as far as the structure will permit, all round the room (except over the desks at B and E), there are two *firmly* fixed shelves. The lower one is about 1 foot above the top shelf of the work-tables, and the other *not less* than 1 foot 3 inches higher. Depth about 8 inches.

10. *Cupboards* for specimens, with glass doors, fixed against the wall at a convenient height over the desks at B and E. These cupboards should be very broad, and neither too high nor too deep, so that as many specimens as possible within them may be visible from outside.

11. *Furnace,* with plate and sand bath in the centre of the back wall. Facing the furnace, there is, on the right of it, the flue from the down draught of the lecture table. Still further on the right—

12. *Draught-cupboard* as long as possible, 2 ft. deep and 3 ft. high. Gas jet in flue. The flue opens ultimately into the furnace flue from the lecture table.

13. *Still,* on separate fire, placed on the left of the furnace.

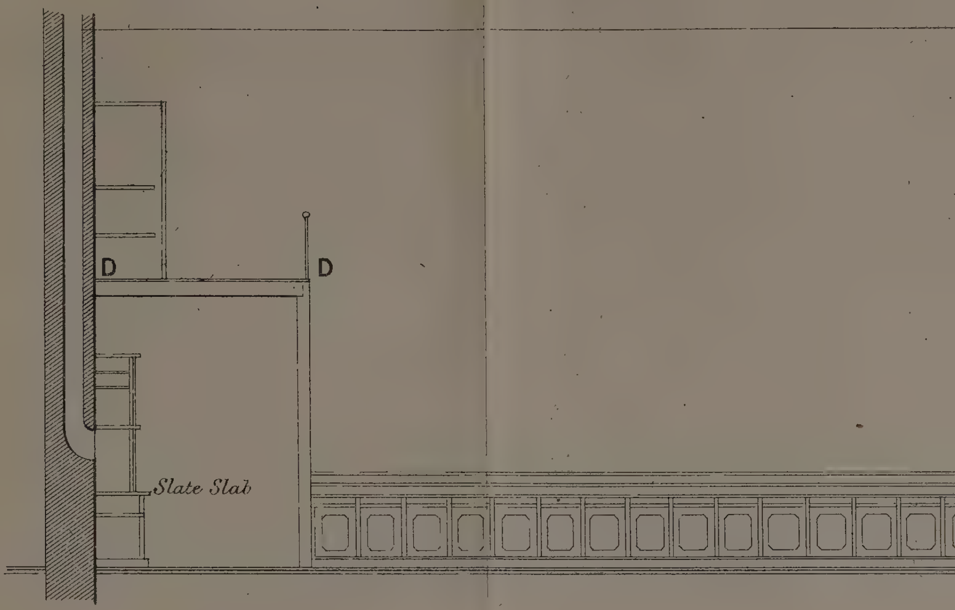
14. *Gas* burners or chandelier for supplying light during lectures on foggy days.

15. *Exercise chest.* A small wooden chest, similar to that in the mathematical theatre of the College, but with a sliding door, which can be altogether removed at pleasure, and containing about 200 partitions, is placed at the back of the class benches. Each partition is about 2⅝ inches broad, 4 inches deep, and ¾ of an inch high.

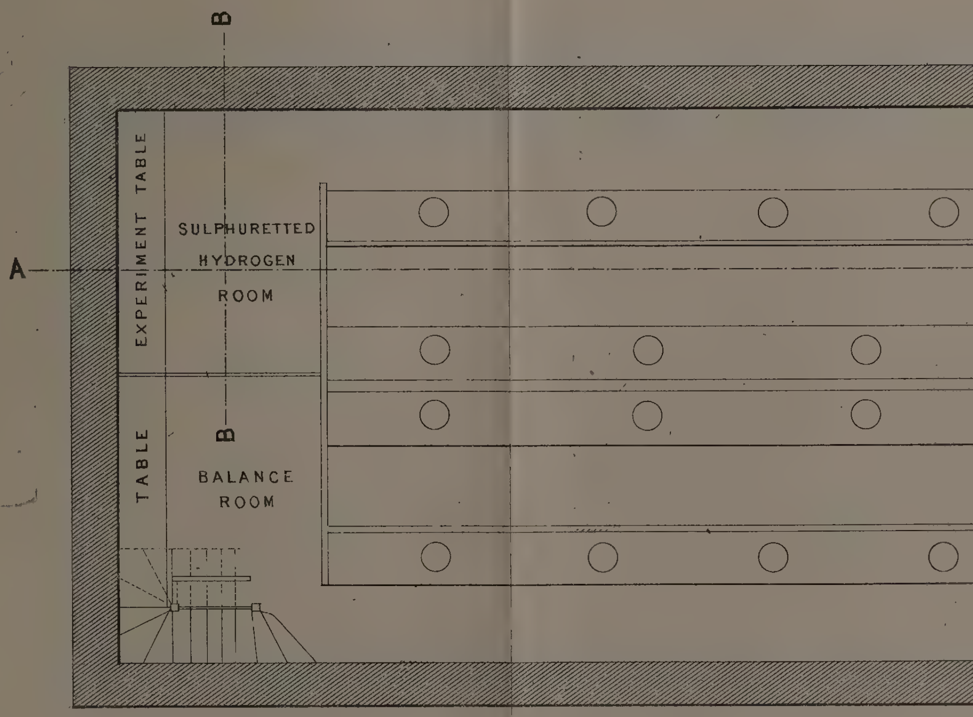
MANCHESTER.

There are, in the Manchester Grammar School, two distinct Chemical Laboratories: the old one, in which the Laboratory and Lecture Room are conjoined; and the new

MANCHEST

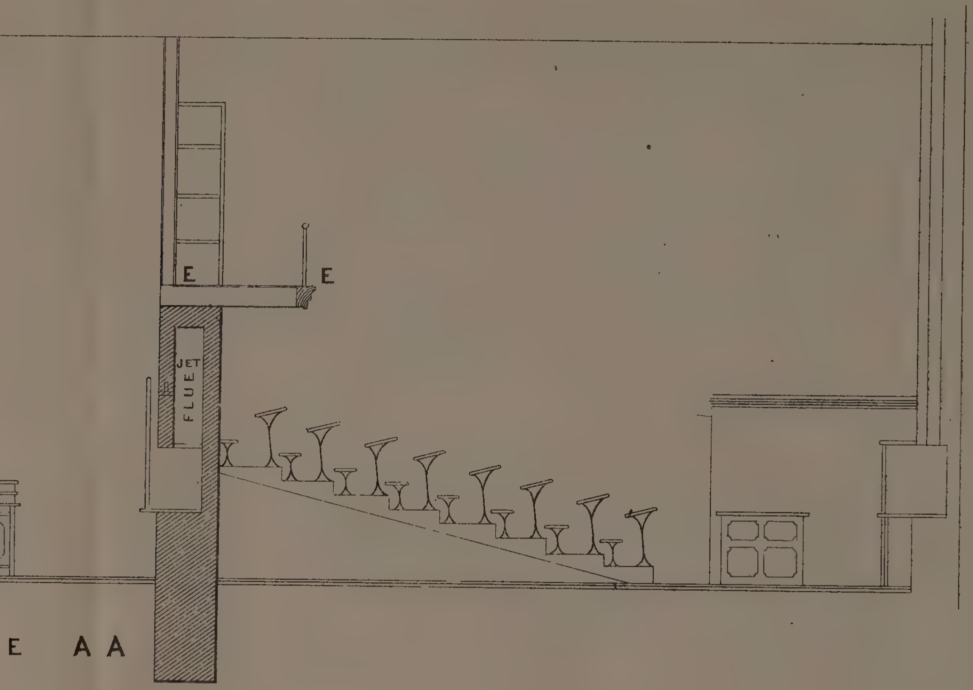


SECT

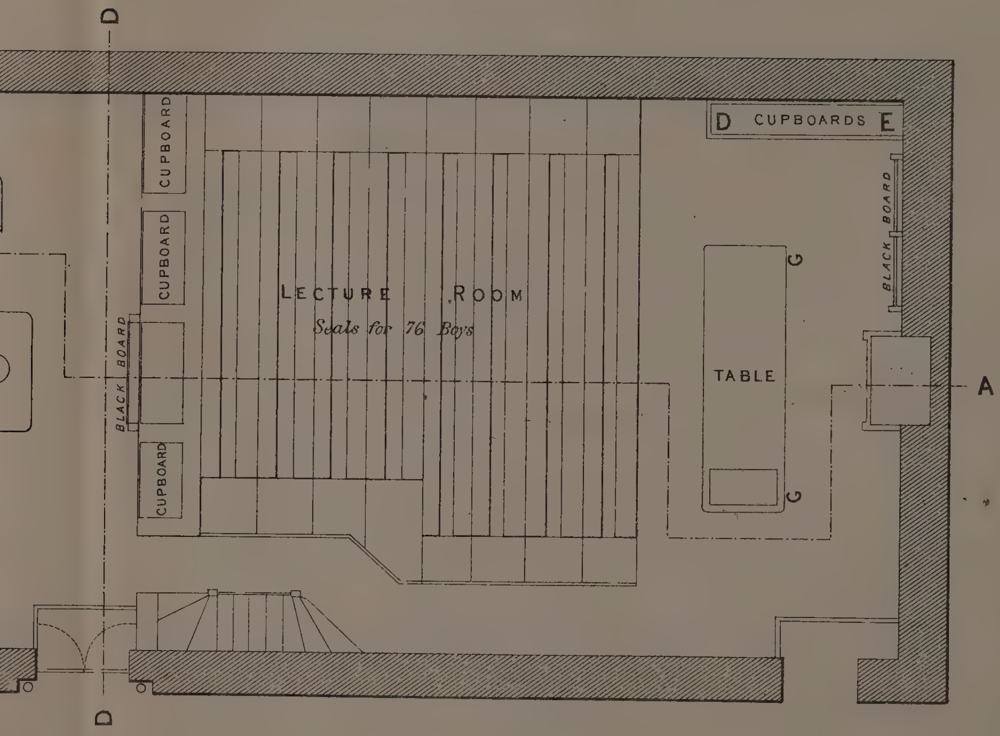


MMAR SCHOOL.

ORY.



E AA

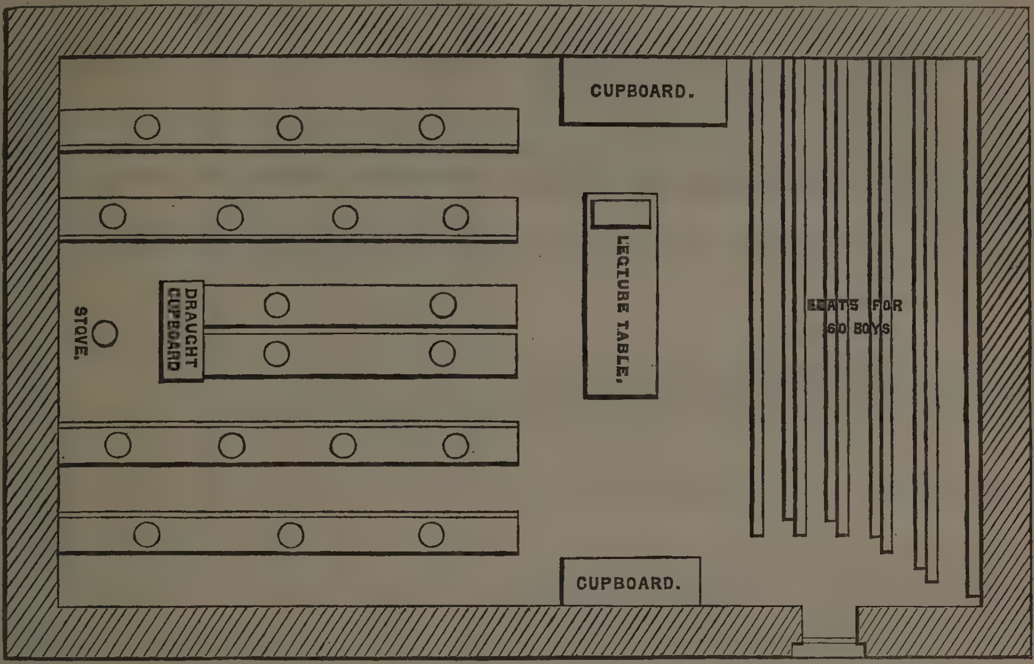


AN

ch

Vincent Brooks Day & Son Lith.

one, in which they are separated. Both these Laboratories are comprised in one large building, occupying the site of the original Grammar School, built by Hugh Oldham. The arrangements of the two Laboratories are thus described by Mr. Francis Jones :



Ground Plan of the Old Laboratory at the Manchester Grammar School.

I.—*The Old Laboratory and Lecture Room.*

This Laboratory was fitted up in 1868, and was previously one of the ordinary schoolrooms. Its arrangements are shown in the accompanying plan, from which it will be seen that the lecture table separates the Laboratory from the lecture seats and desks. The cupboards on either side and others fixed to the wall, and not shown in the ground plan, contain the apparatus used during lectures, as well as the solutions and solid substances given to the boys for analysis. Above the lecture table, a glass cupboard, connected with a good draught, serves to contain any apparatus evolving unpleasant or poisonous odours. The remaining portion of the room is fitted up as a laboratory. It is arranged to accommodate 30 boys, each of whom is provided with a cupboard for apparatus, and with a set of reagents, which are placed on shelves fixed to the top of the table. Gas and water taps are fixed at convenient distances along the tables. The small circles marked on the plan denote the positions of the sinks for waste water. A draught cupboard for general use is placed at the end of the double table in the middle of the room, and behind it is a stove which is used for warming the room as well as for heating crucibles, &c. Ventilation is provided for by means of small windows, and also by a flue above the large gas burners used for lighting the room. The cost of this Laboratory and Lecture Room was 350*l*.

II.—*The New Laboratory and Lecture Room.*

When the increasing size of the Grammar School required the erection of new buildings the old School (a building 93 feet long by 28 broad) was converted into the present Laboratory; the alterations were completed in 1871. The accompanying sketch shows the ground plan and elevation of the four rooms of which the laboratory consists. These are :—

A.—The Lecture Room.
B.—The Laboratory.
C.—The Balance Room.
D.—The Sulphuretted Hydrogen Room.

A.—*The Lecture Room.*

This room is 32 feet long by 24 feet broad, and has seats and desks constructed for 76 boys, but capable of accommodating 90 without inconvenience. These seats rise tier above tier so as to command a good view of the experiments performed at the table. The lecture table is well supplied with gas and water taps, and has likewise binding screws fixed in it, connected with wires which pass along the floor to the galvanic battery, which is placed in the draught cupboard behind the table. By this means space is saved on the table and the fumes arising from the battery are kept out of the room. The draught cupboard, which is well seen from the seats, is constructed as far as possible of glass, and is used for all experiments which give rise to unpleasant odours. The apparatus used for the lectures is contained in seven cupboards, two of which (marked D. E. on the plan) are close to the lecture table, and the remaining five are in the gallery (E. E.). The windows are all provided with sliding shutters which can be very rapidly closed; they are made of blackened wood and exclude daylight completely. By this means the room can be perfectly darkened in one minute for the performance of experiments which require the absence of daylight.

B.—*The Laboratory.*

The Laboratory is 48 feet long by 24 feet broad, and is provided with four working tables, the centre one being double. These tables are provided with 84 cupboards and drawers, which contain the apparatus belonging to the boys. The drawer is so connected with the cupboard that one key suffices to lock both.

The common reagents are placed in shelves at the back of each table, and special reagents are placed in suitable parts of the Laboratory for general use. The small circles marked on the tables in the general plan, denote the positions of the water-taps and basins, and near them, at convenient distances, are the gas taps, of which there are 40. The cupboards at the end of the Laboratory contain the substances given to the boys for analysis, and also the stock of reagents for filling the smaller bottles on the shelves. A draught cupboard similar to the one already described is placed beside the reagent cupboards. In the gallery (D. D.) are five more cupboards containing various chemicals and apparatus.

Although the laboratory contains cupboards for 84 boys, the number working at one time never exceeds 40, each of whom is provided with a Bunsen lamp, a retort stand, and set of chemical reagents. With these exceptions, each boy provides his own apparatus.

C.—*The Balance Room.*

The balances are contained in a small well-lighted room at the end of the Laboratory, as shown on the plan. It contains two fine Oertling's balances, and a smaller one for less exact weighings. The Library of the Philosophical Society connected with the School, is also kept in this room.

D.—*The Sulphuretted Hydrogen Room.*

The corresponding room to the Balance Room, on the opposite side of the Laboratory, is fitted up with three large draught cupboards for the use of the boys. In this room all experiments with sulphuretted hydrogen, chlorine, and other injurious gases, are performed.

The Laboratory is used chiefly by the three Science Forms, the highest two of which work in it six hours weekly, and attend, besides, two lectures on Chemistry. The boys of the Lowest Science Form attend one lecture weekly, and work in the Laboratory for two hours. The boys of the Highest Mathematical Form in the School work one hour weekly at Practical Chemistry; and two of the Modern Language Forms devote three hours weekly to Chemistry, the time being equally divided between lecture and laboratory work.

The cost of the two Laboratories, with the fittings, has been 990*l.*

CLIFTON.

Plans are given of Chemical and Physical Laboratories and Lecture Rooms proposed to be erected at Clifton College, to replace the smaller ones which have been in use up to the present time.

General Remarks on Laboratories for Science Schools.

The Commissioners will observe from the replies received that, whereas chemistry is practically taught in many schools, the boys willingly giving up much of their play time to laboratory work in this subject, with the exception of University College School and King's College School, there is no school physical laboratory.

There is also an opinion among the Head Masters that, on the whole, it is better to begin with the elementary facts of physics than with chemistry.

There are many indications that the teaching of even the elementary parts of physics to young boys is best accomplished by associating the teaching with experiments, and by allowing the boys to do the latter for themselves, as far as possible.

It is clear that for this junior teaching much apparatus and a specially prepared room are not necessary; for the higher teaching special arrangements are as necessary as they are universally considered to be in the case of chemistry.

There are now in America several such laboratories, in which large classes of students perform various experiments instead of, or in addition to, attending lectures.

One of the first institutions to attempt this method was the Massachusetts Institute of Technology in Boston. In this system, obviously, the great difficulty is to enable twenty or thirty students to perform the same experiment without duplicating the apparatus, and to avoid the danger of injury to delicate instruments. The plan adopted at the Institute in question has thus been described by Professor Pickering :—

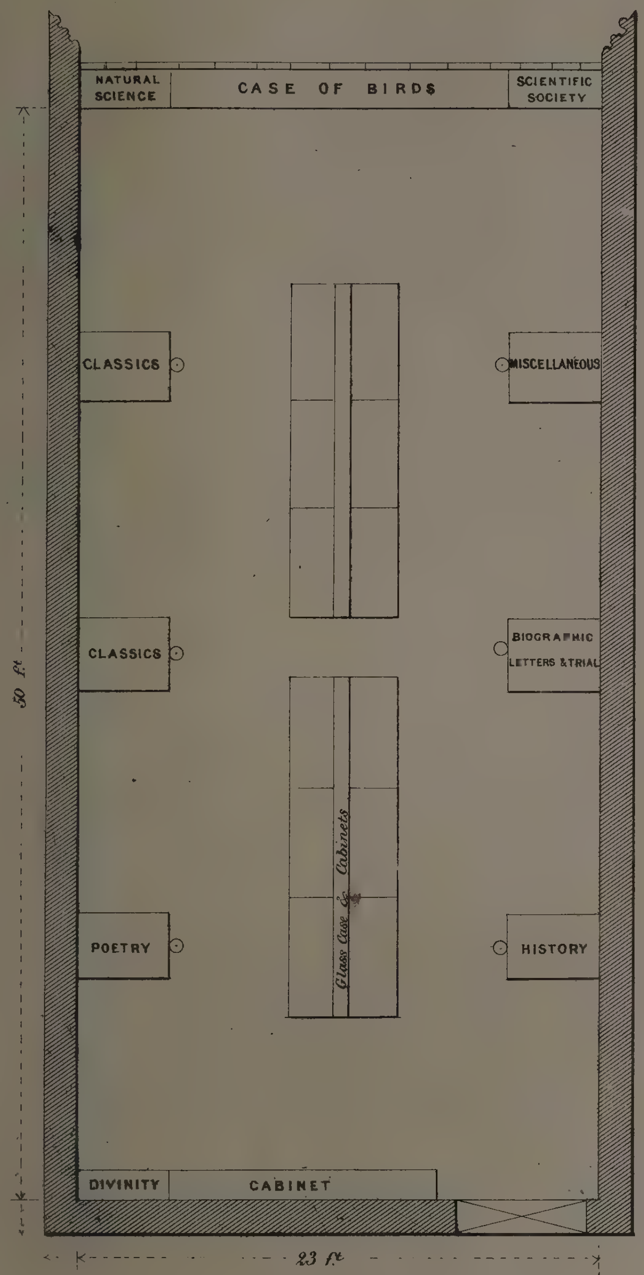
"Two large rooms (one nearly a hundred feet in length) are fitted up with tables, supplied with gas and water, somewhat like a chemical laboratory. On each is placed the apparatus prepared for a single experiment, which always remains in this place, thus avoiding the danger of breaking it in moving. A full written description is also given of each experiment, pointing out the proper precautions to avoid error or breakage. Near the door is an indicator or board containing the names of the experiments, and opposite each is placed a card bearing the name of the student. When the class enters the laboratory, they go to the indicator, and each member notices what experiment is opposite his name; he then goes to the proper table, reads the description, and performs it. He next reports his results to the instructor in charge, and if they are correct his card is moved to some unoccupied place, and he proceeds as before. Care is taken that the number of experiments shall exceed that of students, and there is therefore no delay. The instructor in the meantime is enabled to pass from student to student, and to see that no errors are committed. As quantitative work is far more valuable than qualitative, most of our experiments are of the former kind, and the student learns to measure physical constants, and to verify laws numerically. For example, in one experiment a steel bar is supported on knife edges, and a weight is applied at the centre. The flexure is then measured by a micrometer screw, the exact point of contact being determined by including the screw and bar in the circuit of a battery and galvanometer. After making a number of experiments with various weights, the student constructs a curve, in which ordinates represent deflection, and abscissæ weights applied. The law of elasticity shows that this curve should be a straight line, and the close agreement is convincing proof to the student of its correctness. In the same way the law of the conjugate foci of lenses is tested, and the observed curve compared with that deduced from theory. Some experiments are introduced to accustom the student to general methods of research, such as the computation of probable error by least squares, various forms of interpolation, &c. The graphical method is largely used, as it at the same time enables the student to take in all his observations at one glance, while the instructor can constantly tell how carefully the work has been done. For the microscope a few objects are selected to show certain general methods of using this instrument, as one requiring a diaphragm, a second oblique illumination, and so on. Again, the student views by polarised light such objects as unannealed glass, crystals, designs in selenite, and studies the effects produced by various agencies. By thus handling the instruments, he acquires a facility in using them, and comprehension of their construction which he could never obtain from lectures. The excellence of the work done by many of the students led to the hope that valuable results might be obtained by assigning to different students the experiments in a research, taking care that each should be repeated several times by different individuals. These results, if concordant, would be much more conclusive than those obtained by a single experimenter, since they would be free from all personal bias. In this way some interesting results have been attained on the foci of lenses placed obliquely, the flow of air through straight and curved tubes, and other similar subjects. Photometry and electrical measurement seem especially suited to this purpose, and the application of the latter subject to submarine cables would be both interesting and instructive to the student. During the winter time of 1869 and 1870 about sixty students worked in one laboratory, so that the experiment was tried on a sufficiently large scale to enable us to speak with confidence of its success. We found the system described above worked well, the students were interested in the subject, and obtained results of considerable accuracy. The loss by breakage was exceedingly small, and the current expenses insignificant compared with a chemical laboratory, since there is but little consumption of the materials employed."

The following suggestions as to the amount of space requisite and the arrangements for chemical laboratories have been made by the Science and Art Department, and published in the *Science Directory* for the information of Committees of Schools who propose to erect buildings or to convert existing buildings to school use. It is expressly stated that they are to be considered merely as suggestions, and not as absolute rules to be followed implicitly under all circumstances; still, as suggestions merely, they are so valuable that I append them and the accompanying plans.

1. *Laboratory for 20 Students.*

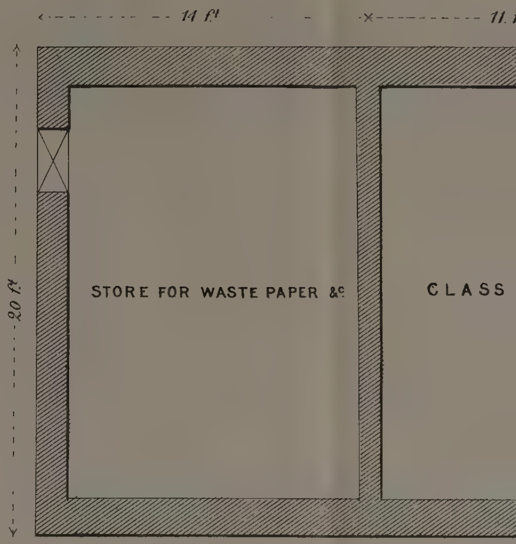
"A room about 35′×19′, 16′ high to ceiling (or collar beam), lighted by windows on both sides and, if possible, a skylight, and fitted up with working benches. The method of arranging these benches must depend upon the special circumstances of the case, but, when possible, a very convenient way is to arrange them in groups of four along the side walls. Each working space should be 3′ 6″×2′ 6″, which would make each group 7′×5′, and in a room of the above dimensions a passage of 5′ (which might, however, be reduced to 4′) would be left down the middle of the room between the ends of the benches, and about 6′ would be left in the clear between the benches. Five groups of benches would accommodate the 20 students. Three groups would be on one side of the room, and the benches of the third group might be made a little longer to give more room to advanced students. On the other side of the room would be two groups of benches, and opposite the third group of the first side would be a space for sand bath, steam apparatus, gas furnaces, &c.

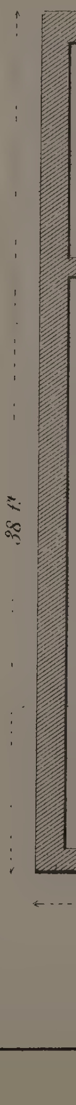
"In each wall space between the benches should be a closet about 16″×9″ and 2′ high for sulphuretted hydrogen. The closet should have a flue which may be made of 2″ drain pipe carried up in the wall, and the draught maintained in it by a small gas jet, or if there be a good upcast shaft from furnaces in the basement these flues may be led into it.

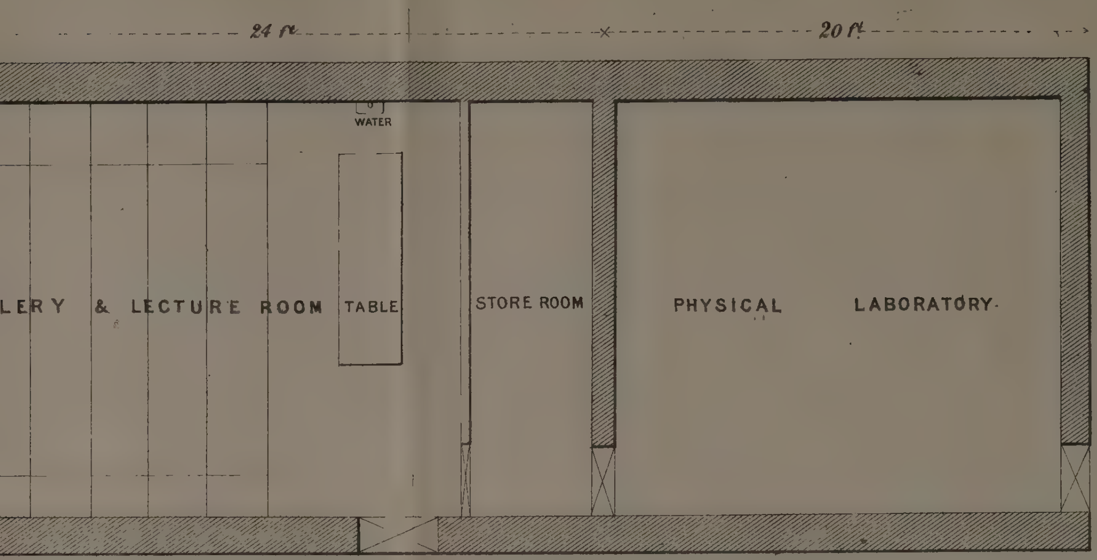


Plan of Museum

Scale ⅛ one Foot

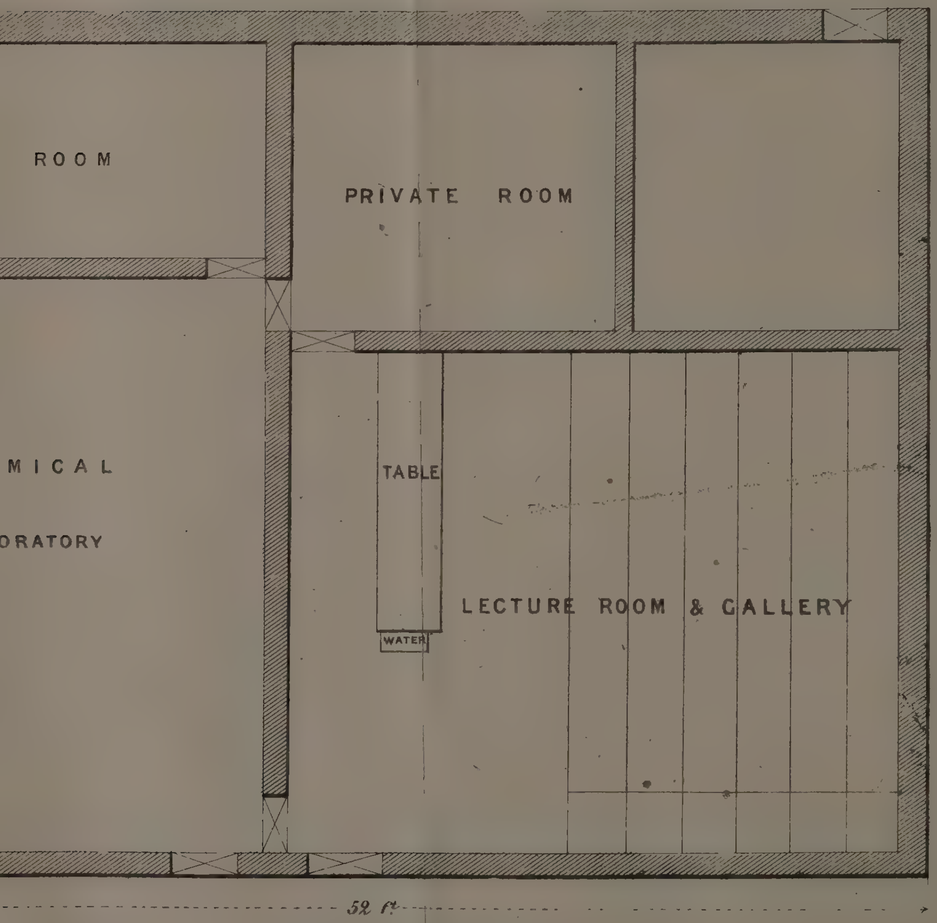






n of Physical Laboratory

IFTON COLLEGE



Plan of Chemical Laboratory

“ Another way of arranging these closets, which has been found to answer where there is a good upcast shaft, is to construct them of wood and put one on each working bench, a wooden tube carried along the top of the bench to the wall, and thence along the wall forming the flue from it to the shaft. In this case it would probably be found better to arrange the benches together, and have the passage down one side of the room instead of the centre.

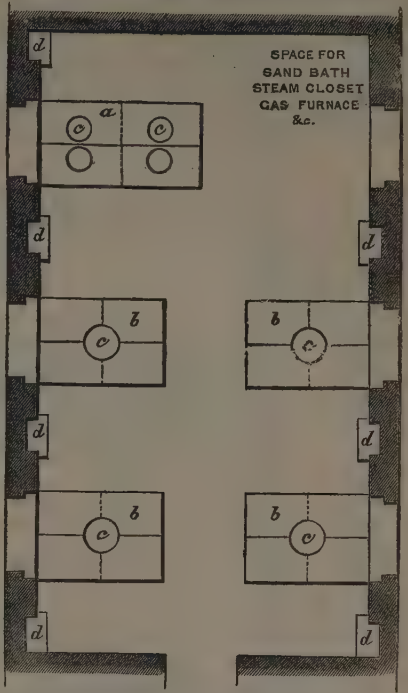
“ Each worker should have gas laid on to his space; one sink and water tap between two is sufficient, or one sink with two taps, in the centre of each group of benches, except for the advanced students, for each of whom it will be well to provide a sink and a double tap.

“ A room about 14′ × 12′ should be provided for balances and other delicate apparatus. This might also serve as an office for the professor.

“ There would, doubtless, in the same school be other classes, in which case a lecture theatre would be provided for general use. In close proximity to this should be a preparation room fitted with working table, gas furnaces, steam apparatus, &c., to enable the professor to prepare for his lectures. A good flue will here be necessary to remove noxious gases, &c., and it might serve also for the lecture room.

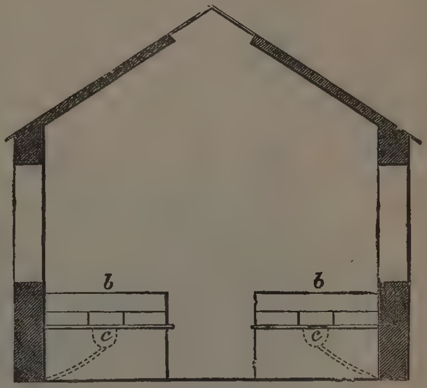
“ The laboratory would be best placed either under a separate roof from the other class rooms, or in the top storey of a building, of which the ground floor would give space for the other class rooms, and the basement would contain the heating apparatus, washing and cloak rooms, metallurgical furnaces, and space for any other work which from its nature could not be carried on in the general laboratory.”

“ Plan of Laboratory for 20 Students.



“ *a.* Group of four benches for advanced students.
“ *b.* Groups of four benches for elementary students.
“ *c.* Sinks, each with two water taps.
“ *d.* Niches for sulphuretted hydrogen closets.

Skylight.



“ Section.
“ Scale, 10 feet to an inch.”

2. *Laboratory for* 50 *Students.*

“ A laboratory about 50′ × 19′ should be provided for 30 elementary students. This should be fitted with working benches, &c., as the laboratory described above.

“ A second laboratory about 36′ × 22′ 6″, or 43′ × 19′, should be provided for 20 advanced students.

“ Each advanced student should have a space 4′ 6″ × 2′ 6″, with a sink, double water tap, two gas jets, and if possible a sulphuretted hydrogen closet to himself.

“ There should be a steam closet, sand bath, gas furnaces, &c., as in the other laboratory.

“ A balance room should be provided in close proximity to the advanced laboratory.

“ An operation room should be provided. This may be with the furnaces, &c., in the basement.

“ In a school of this size it would probably be found advisable to provide a private laboratory for the professor. A room about 12′ × 16′ would be sufficient. It should be fitted with working table, steam closet, gas furnaces, &c.

“ A chemical library would also be very desirable. This might be kept in the same room as the balances.

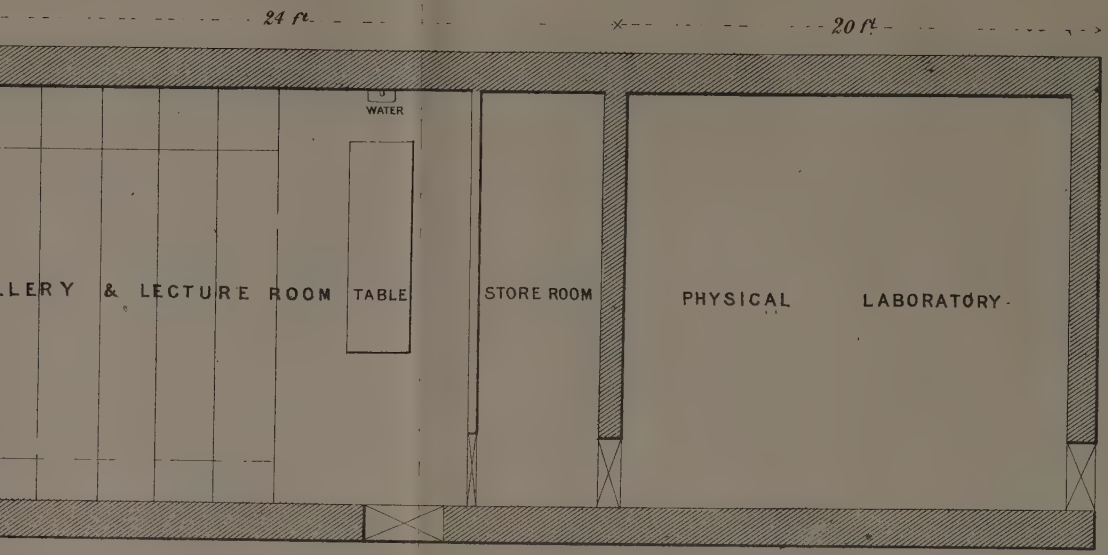
“ To save space, one of these laboratories might be constructed above the other,; but it is better to have nothing over a laboratory, so that there may be skylights and ample means of clearing out noxious gases.”

---

§ 12.—OBSERVATORIES.

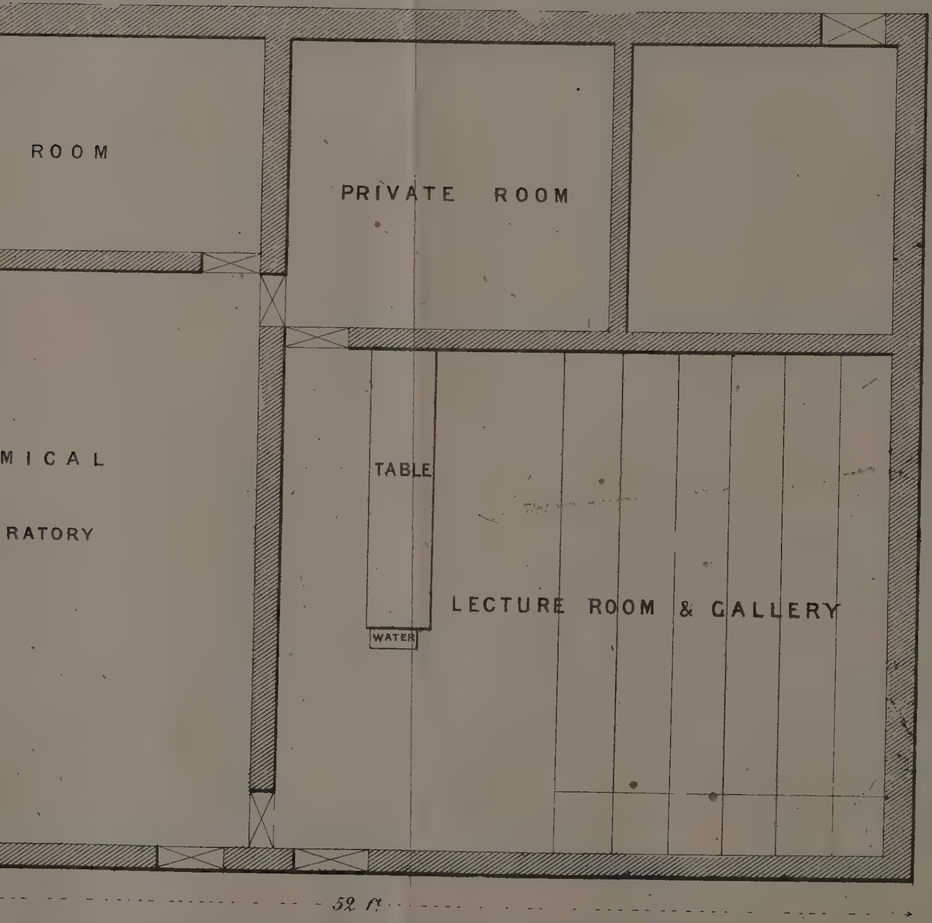
Up to the present time, a Telescope, to say nothing of an Observatory, has been by no means considered as a necessary instrument for Scientific Teaching in Schools. Nevertheless, both at Rugby and Eton Observatories have been erected, to which attention must be drawn.

The Temple Observatory at Rugby, which is now playing an important part in the science education at that school, is a wooden building of unpretending appearance, both inside and out; it is in fact built entirely for work. The accompanying plan and drawing, taken from a photograph, will render the following description of it more clear. The circular roof covers the 8¼ in. refractor by Alvan Clark, and round the walls are shelves and tables for books, maps, &c. In the small room adjoining are kept spectroscopes and other instruments when not in use on the telescope; a Sprengel air pump, and vacuum tubes, batteries, and coils for examination of the spectra of gases, are also in this room; a heliostat above reflecting sunlight down for comparison. At the end of this room is placed a reflector, 12 in. aperture, by With, the whole of the mounting for which has been made in the town of Rugby, according to the plans and with the assistance of Mr. Seabroke, and is good and substantial throughout, although without polish. The spectroscope made on the return principle is also of local manufacture, costing, we believe, about 10*l.* only, without the prisms, five in number, each used twice. The observatory is under the charge of Mr. Wilson and Mr. Seabroke, and one or both of them are there every fine night, when any of the boys are permitted to come and observe; generally there are three or four present. The work consists of measuring positions and distances of double stars, in which the boys join, their readings being



n of Physical Laboratory

IFTON COLLEGE



Plan of Chemical Laboratory

"Another way of arranging these closets, which has been found to answer where there is a good upcast shaft, is to construct them of wood and put one on each working bench, a wooden tube carried along the top of the bench to the wall, and thence along the wall forming the flue from it to the shaft. In this case it would probably be found better to arrange the benches together, and have the passage down one side of the room instead of the centre.

"Each worker should have gas laid on to his space; one sink and water tap between two is sufficient, or one sink with two taps, in the centre of each group of benches, except for the advanced students, for each of whom it will be well to provide a sink and a double tap.

"A room about 14′ × 12′ should be provided for balances and other delicate apparatus. This might also serve as an office for the professor.

"There would, doubtless, in the same school be other classes, in which case a lecture theatre would be provided for general use. In close proximity to this should be a preparation room fitted with working table, gas furnaces, steam apparatus, &c., to enable the professor to prepare for his lectures. A good flue will here be necessary to remove noxious gases, &c., and it might serve also for the lecture room.

"The laboratory would be best placed either under a separate roof from the other class rooms, or in the top storey of a building, of which the ground floor would give space for the other class rooms, and the basement would contain the heating apparatus, washing and cloak rooms, metallurgical furnaces, and space for any other work which from its nature could not be carried on in the general laboratory."

2. *Laboratory for* 50 *Students.*

"A laboratory about 50′ × 19′ should be provided for 30 elementary students. This should be fitted with working benches, &c., as the laboratory described above.

"A second laboratory about 36′ × 22′ 6″, or 43′ × 19′, should be provided for 20 advanced students.

"Each advanced student should have a space 4′ 6″ × 2′ 6″, with a sink, double water tap, two gas jets, and if possible a sulphuretted hydrogen closet to himself.

"There should be a steam closet, sand bath, gas furnaces, &c., as in the other laboratory.

"A balance room should be provided in close proximity to the advanced laboratory.

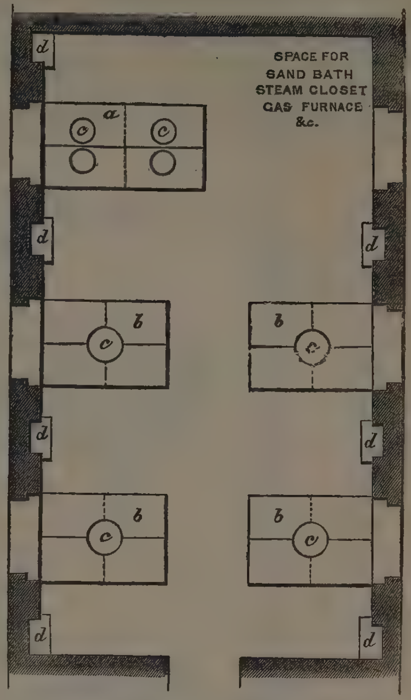
"An operation room should be provided. This may be with the furnaces, &c., in the basement.

"In a school of this size it would probably be found advisable to provide a private laboratory for the professor. A room about 12′ × 16′ would be sufficient. It should be fitted with working table, steam closet, gas furnaces, &c.

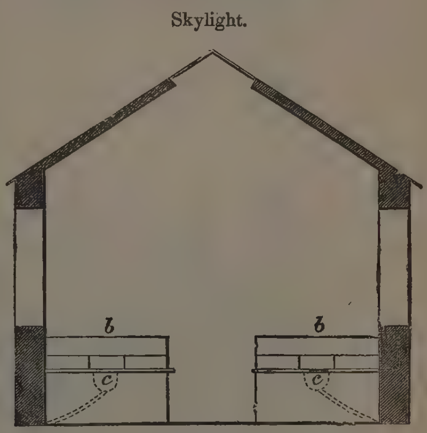
"A chemical library would also be very desirable. This might be kept in the same room as the balances.

"To save space, one of these laboratories might be constructed above the other,; but it is better to have nothing over a laboratory, so that there may be skylights and ample means of clearing out noxious gases."

"PLAN OF LABORATORY FOR 20 STUDENTS.



" *a.* Group of four benches for advanced students.
" *b.* Groups of four benches for elementary students.
" *c.* Sinks, each with two water taps.
" *d.* Niches for sulphuretted hydrogen closets.



"Section.
"Scale, 10 feet to an inch."

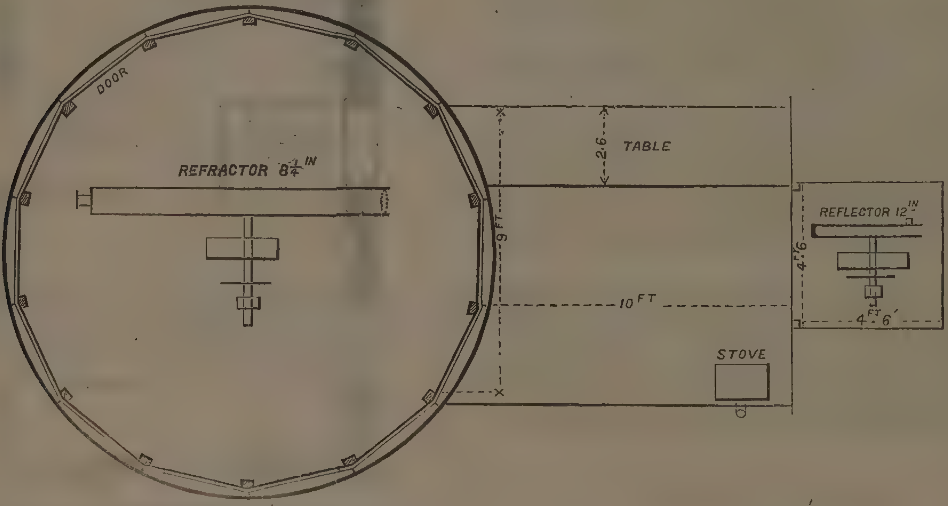
---

§ 12.—OBSERVATORIES.

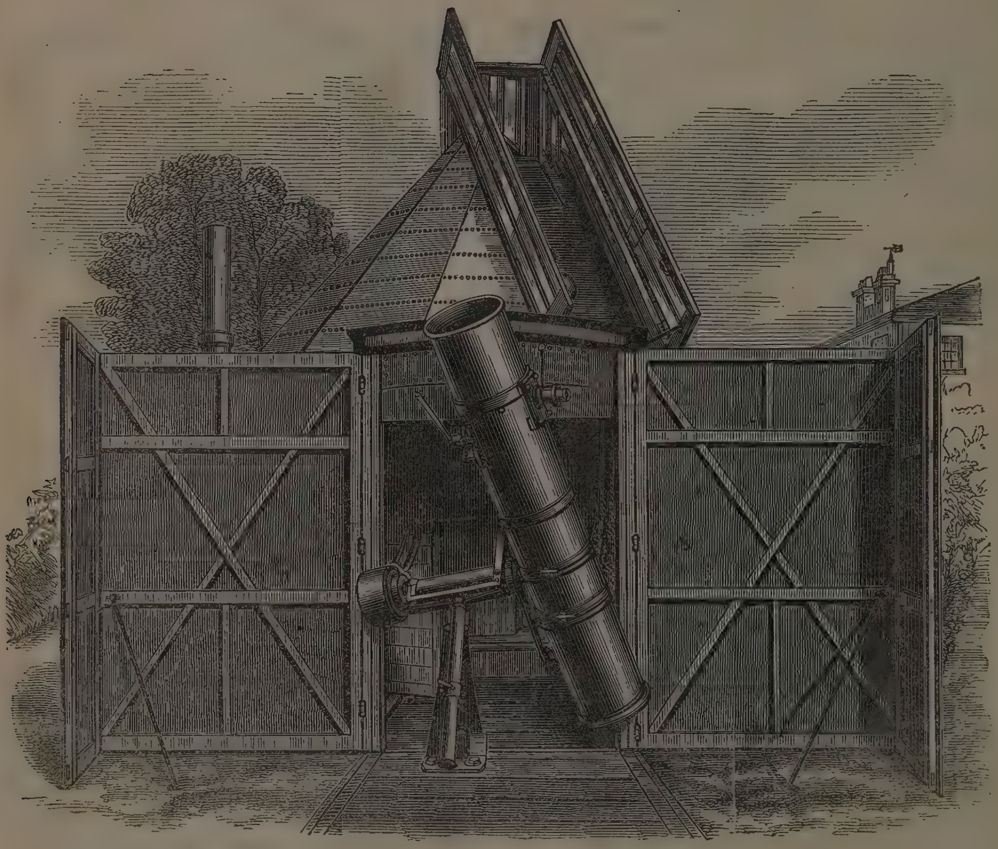
Up to the present time, a Telescope, to say nothing of an Observatory, has been by no means considered as a necessary instrument for Scientific Teaching in Schools. Nevertheless, both at Rugby and Eton Observatories have been erected, to which attention must be drawn.

The Temple Observatory at Rugby, which is now playing an important part in the science education at that school, is a wooden building of unpretending appearance, both inside and out; it is in fact built entirely for work. The accompanying plan and drawing, taken from a photograph, will render the following description of it more clear. The circular roof covers the 8¼ in. refractor by Alvan Clark, and round the walls are shelves and tables for books, maps, &c. In the small room adjoining are kept spectroscopes and other instruments when not in use on the telescope; a Sprengel air pump, and vacuum tubes, batteries, and coils for examination of the spectra of gases, are also in this room; a heliostat above reflecting sunlight down for comparison. At the end of this room is placed a reflector, 12 in. aperture, by With, the whole of the mounting for which has been made in the town of Rugby, according to the plans and with the assistance of Mr. Seabroke, and is good and substantial throughout, although without polish. The spectroscope made on the return principle is also of local manufacture, costing, we believe, about 10*l.* only, without the prisms, five in number, each used twice. The observatory is under the charge of Mr. Wilson and Mr. Seabroke, and one or both of them are there every fine night, when any of the boys are permitted to come and observe; generally there are three or four present. The work consists of measuring positions and distances of double stars, in which the boys join, their readings being valued according to their experience; those who are not actually observing, receiving instruction till their turn comes round. In the daytime, when the sun is visible, Mr. Seabroke notes the positions and heights of the solar prominences, in which he is sometimes assisted by the boys, who also make drawings of the prominences and spots. Mr. Wilson is also occasionally assisted by the boys in calculating the orbits of binaries. The methods followed are those proposed in the *Philosophical Transactions* by Herschel, one almost entirely graphical and the other analytical; both are used in order that each may check the other.

I gathered from the observatory note book that a number of drawings have been made of Venus, Jupiter, Mars, towards which the boys have contributed largely; there are also drawings of Encke's comet, together with its spectrum.



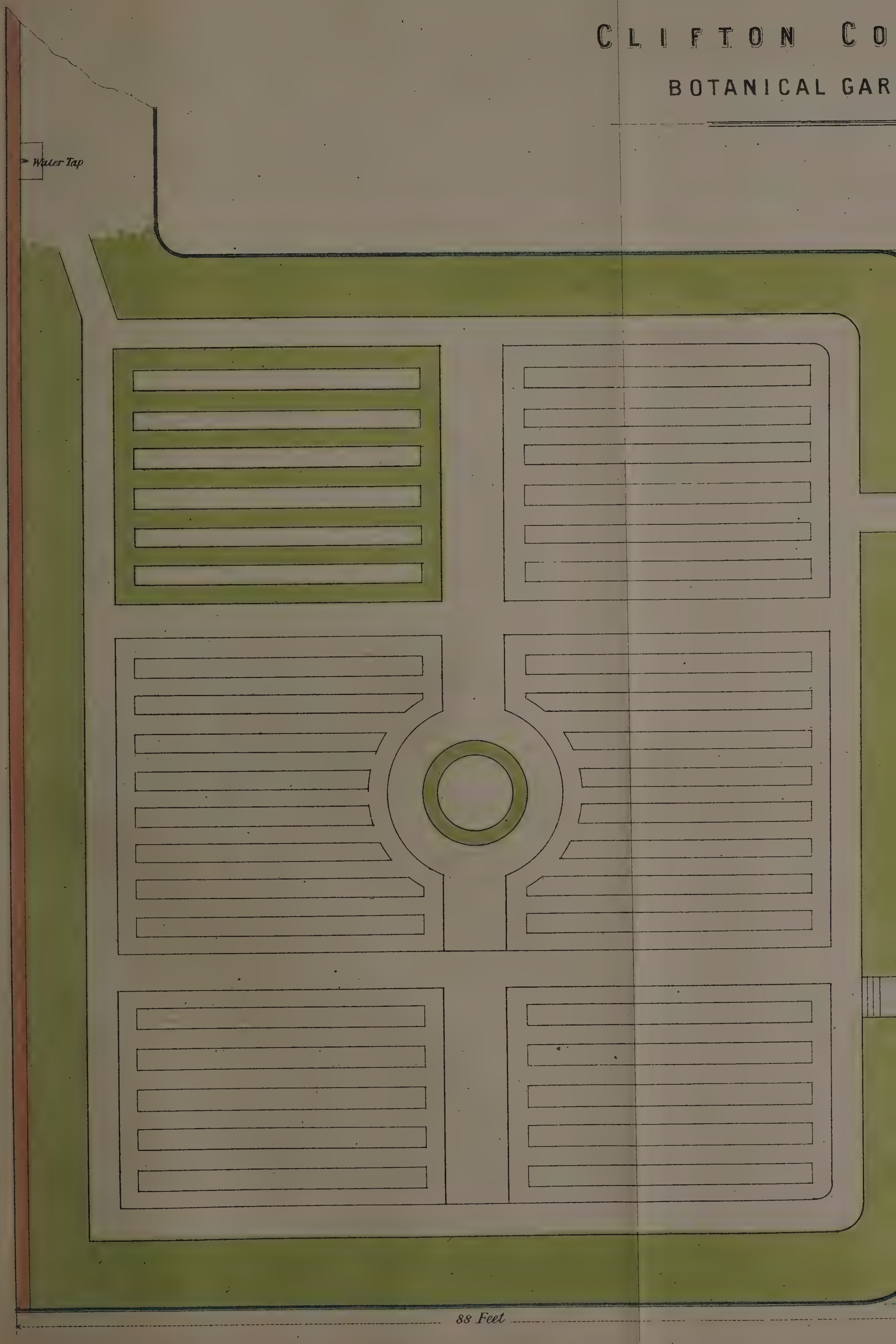
Ground Plan of the Rugby Observatory.

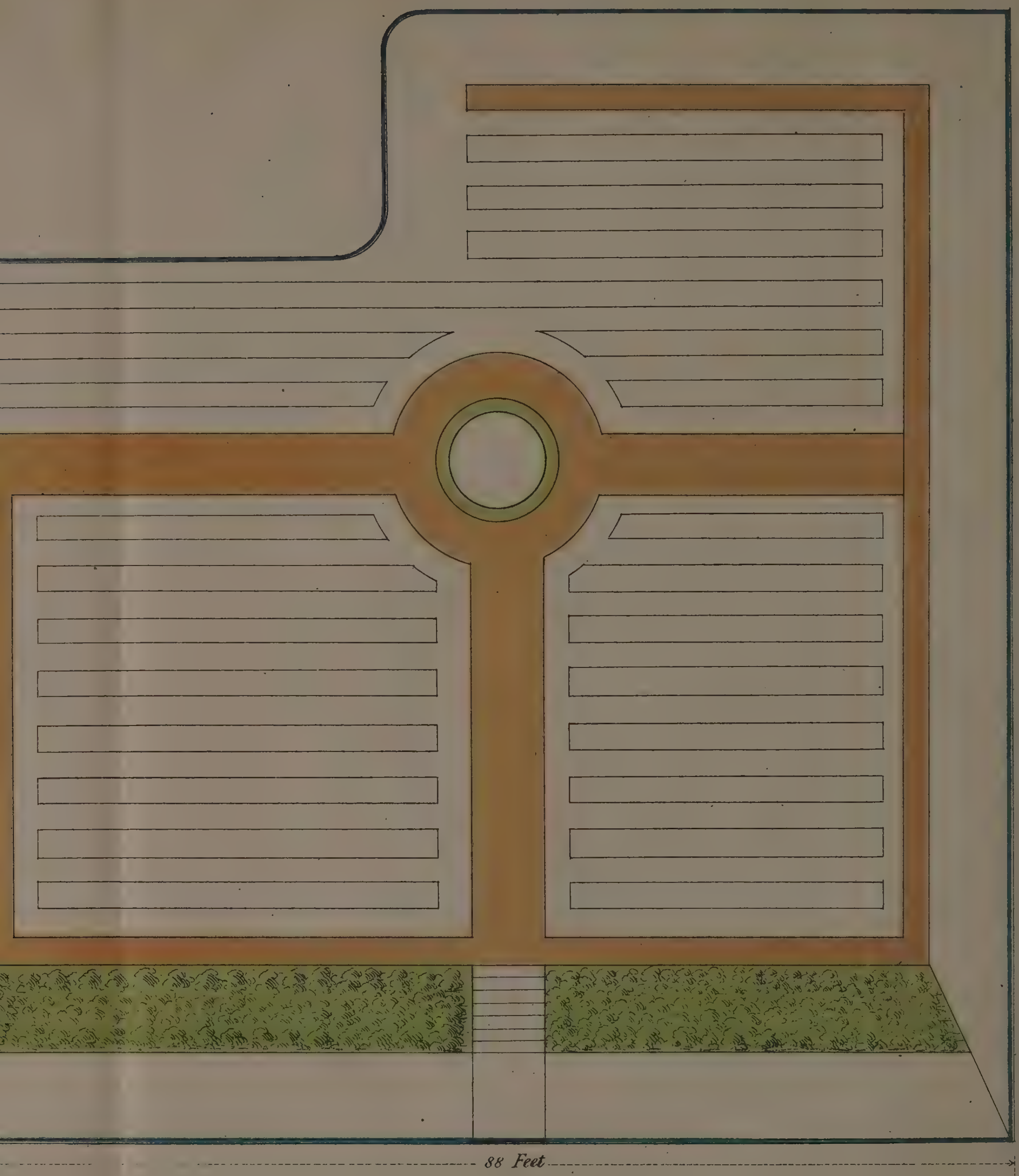


View of Temporary Observatory for Reflector.

CLIFTON CO

BOTANICAL GAR



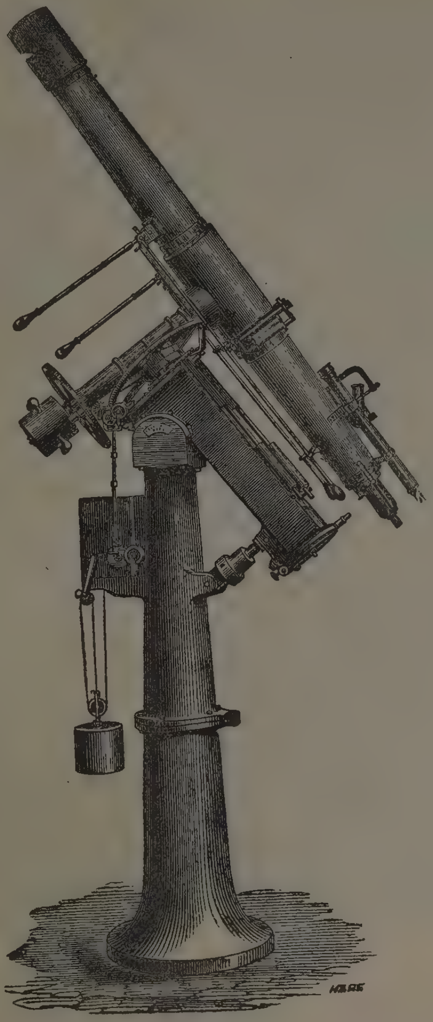


Scale 12 Feet to an Inch.

Vincent Brooks Day & Son, Lith

The Telescope at Eton, recently given to the school by the energy and liberality of some of the Masters, is a refractor, with objet glass of 5·9 inches clear aperture and 88 inches focus, and was made by Messrs. Cooke and Sons, of York, who also supplied the observatory and superintended the erection of the telescope. It is, as will be seen from the drawing, mounted equatorially on the German system, with declination circle reading to 10″ of arc, and hour circle reading to 2″ of time. The mechanical details do not, with one exception, deviate materially from the pattern usually adopted by Messrs. Cooke.

The telescope is furnished with a sufficient battery of eye-pieces, of powers ranging from 30 to 400, and also with a bilfilar micrometer. The position circle is permanently attached to the lower end of the main tube. The observatory is erected on the roof of the western tower of the New Schools. It is square, and surmounted by a revolving dome. It is obvious that an instrument erected on a tower cannot be wholly free from vibration; but the latter is reduced to a minimum by supporting the telescope on two massive trussed iron girders stretching across the tower. The floor of the observatory is supported quite independently.



THE ETON EQUATORIAL.

Besides these large Observatories at Rugby and Eton, there is a smaller one at Rossall, which is substantially built, and furnished with revolving dome. It contains a 4½-inch refractor, equatorially mounted by Slugg, of Manchester. It has not been used recently.

I am informed that a telescope of considerable power has been purchased for use at Clifton College, but the Observatory is not yet built.

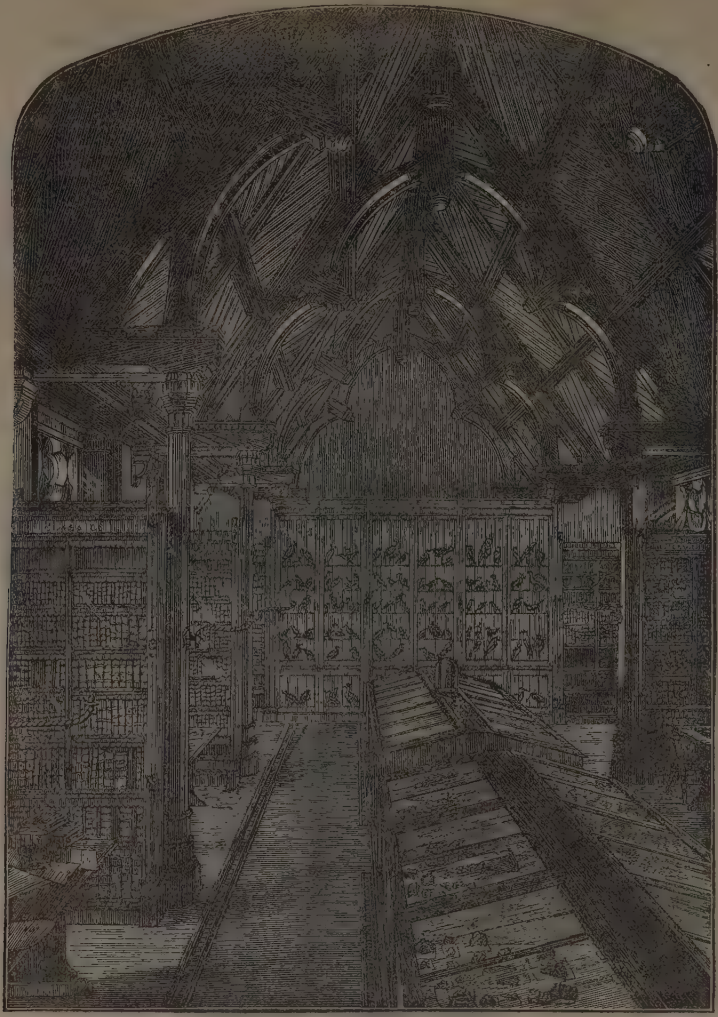
---

§ 13.—MUSEUMS AND BOTANIC GARDENS.

Clifton College.

The Museum and Botanic Gardens at Clifton College were first projected in 1870, when a fund was begun to defray the cost of their formation and maintenance. A sum of more than 370*l*. has now been raised, and though the expenses have been necessarily heavy, both the garden and the museum are now entirely free from debt.

The Head Master of Clifton College (the Rev. Prebendary Percival), erected at his own expense and presented to the college the extensive building intended for a library and museum. It is a well-lighted apartment in the early English style, 60 feet by 23 feet, and situated on the first floor. It comprises five bays, the lower one being at present used as the secretary's office. The book-cases are fitted in between the windows, so as to form a series of recesses annexed to the windows of the room, with a table in each for study. The library is already well stocked and contains some 1,300 valuable volumes, comprising works of standard authors. The architecture of the library and museum is in character with the rest of the college building, the roof being open-timbered, of ornamental construction, with hammer beams resting on wooden columns. The museum cases are arranged down the centre of the room. The fittings are of polished pine.



THE MUSEUM OF CLIFTON COLLEGE.

The museum must be considered as still in its infancy, but though there are many gaps in the collections, some of them are remarkably good. An important rule was laid down at the very outset, viz., that "the museum shall be essentially a British one, and shall illustrate the natural history and antiquities of our land by good specimens systematically arranged, under the departments of zoology, botany, geology, mineralogy, and archæology. In addition to this, there will be a collection of rare and curious objects, which may be considered useful for the purposes of scientific teaching, and a large typical series to be used at the lectures and demonstrations given in the college on comparative anatomy and other branches of natural history. The committee of management will only accept of such specimens as can be classed under some one of these heads." This rule has been hitherto absolutely adhered to and there is little doubt that its adoption will insure the real utility of the museum, and will make the collections much more perfect than could otherwise be expected.

The late Professor Sedgwick sent one of the best typical collections of mesozoic fossils, consisting of 440 species, and 1,100 specimens. The gift is in every way most valuable, and it is one of the most useful that the museum has yet received. The palæozoic fossils were very imperfectly represented till lately, when a large case was received from the Director-General of the Irish Geological Survey. The specimens are mostly typical, and are all named. Some of them are of great rarity.

Large collections of fossils have also been received from Samuel Worsley, Esq., of Clifton, and many other contributors. The local series of fossils is considered of especial importance in such a museum as this, and under the able superintendence of J. G. Greenfell, Esq., it has already attained considerable dimensions. The expeditions of the geological section of the Clifton College Scientific Society have been the means of procuring large accessions to this collection, and among individual donors, mention should especially be made of J. Rossiter, Esq., and S. G. Perceval, Esq.

The rock specimens are at present few and unimportant, but Professor Phillips, of Oxford, has promised to give shortly a number of duplicates from his splendid collection in the museum of the University of Oxford. The kindness of a Clifton lady (Miss Wills), has lately furnished the museum with a complete series of polished cubes (101 in number), illustrating the rocks of the Avon section at Clifton. They are arranged (in stratigraphical order) in one of the glass cases, and a complete catalogue of them has been prepared for the use of students.

The minerals in the museum comprise not less than 1,000 different kinds, many being very valuable. The greater portion of them was lately acquired in the following manner:—W. Sanders, Esq., F.R.S., wishing to dispose of a large mineral collection which he had formed, kindly offered it to the museum at a sum very much under its real value. He further offered to give one-third of the amount as a donation from himself. The Rev. J. Heyworth, Chairman of the College Council, on hearing of Mr. Sanders' offer, generously contributed another third, and thus, for the small contribution of *ten pounds* from the college fund, this very extensive and excellent set of minerals has been secured. A catalogue of the collection is in preparation, and will shortly be issued.

There is a large collection of shells, arranged in three series, *i.e.*, 1. British land and fresh water shells; 2. British marine shells; 3. Generic examples from all parts. Woodward's *Manual of the Mollusca* has been used in arranging them, and they are now in excellent order. A. Cruttwell, Esq., O. C., was one of the largest contributors to this department, but valuable gifts have been made to it by many others. There are a great many duplicates, which are offered for exchange.

A report on the Lepidoptera of the museum has been drawn up by the Rev. J. Greene.

The Coleoptera are represented by a great number of specimens, and Mr. Barton, an experienced coleopterist, has very kindly undertaken the re-arranging and labelling of them. Professor Westwood, of Oxford, is the contributor of one-half of these insects, and he has given so much time and trouble to the selection and naming of them, that the warmest thanks of the society are due to him. J. F. M. H. Stone is also the donor of a large proportion of the whole collection. In other departments of entomology there are very few examples.

The eggs of British birds are numerous and well arranged; and there are a good many stuffed specimens of British birds, lists of which have been drawn up mainly by J. F. M. H. Stone and P. A. Ogilvie.

The curator of the museum and botanic gardens has lately begun the formation of a zoological series, intended to illustrate typically the leading forms of animal life, and it is hoped that this may be made one of the most interesting portions of the museum, though the limited space at command will prevent it from becoming very extensive.

An Osteological collection has also been undertaken, and it already contains some good specimens, one being a fine elephant's skull, procured for the college museum in India by General McLeod. Both the osteological and the zoological series will be of very great use in instruction, and the curator is anxious to receive additions to them.

The coins form a large collection, and many of them are rare and valuable. W. Baillie and J. Prinsep have for some time been occupied in arranging them, but there is much need of a good cabinet, for the purchase of which funds are needed. R. Bamford, W. Hill, and A. Paul, Esq., O.C., have contributed largely to this department of the museum.

A good museum is of little use without a good scientific library, and a great many standard works of reference, mostly illustrated, have been purchased for the use of the students. A welcome addition to this scientific library has lately been made by Thomas Proctor, Esq., whose donations to the Museum and Botanic Garden have been most munificent. The naming of fossils had hitherto been a difficult task, from the want of good drawings for comparison and reference, but this want Mr. Proctor has now supplied, by presenting to the library an entire set of the publications of the Palæontographical Society. F. F. Tuckett, Esq., has also presented many useful scientific works to the library.

The Herbarium is at present placed in the Museum, suitable drawers having been provided for it. It is now of considerable extent, and most of the plants are uniformly mounted on stiff paper, and labelled. The nucleus of the collection was an old but most extensive herbarium, formed by the late Miss Mills, and contributed by her nephew. The Rev. James Heyworth has lately presented a very large number of specimens, collected by himself (especially rich in ferns and seaweeds), together with another series made by Mr. Thwaites, of Ceylon. It is proposed to make a local herbarium.

It remains to say something of the Botanic Garden. It may be gathered from the announcements of donations made at the Scientific Society's meetings, the gifts to it have been very numerous. The following institutions and private individuals have given the most zealous help in the formation of this garden: the Royal Botanic Gardens, Edinburgh (Professor Balfour); Trinity College, Dublin (Professor Percival Wright); Royal Botanic Gardens, Regent's Park, London (W. Sowerby, Esq.); Royal Botanic Gardens, Glasnevin (Dr. Moore); Botanic Gardens, Hull (J. C. Niven, Esq.); Rev. H. N. Ellacombe, Bitton; J. Saunders, Esq., Clifton; George Maw, Esq., Broseley; J. Backhouse, Esq., York; T. Proctor, Esq., Clifton. Further donations are promised by Dr. Hooker, Kew; Professor Lawson, Oxford; Professor Babington, Cambridge; and J. Richardson, Esq., Liverpool.

The formation of the garden was a work of considerable difficulty, the place assigned to it being exceedingly barren and unpromising. The garden is divided by a path into two portions, each with a neat iron fence. The hedges are formed of the following shrubs: *Berberis Darwinii, Spartium junceum, Ulex europæa flore-pleno, Cerasus Lauro-Cerasus*, var. *Colchica, Rosa indica* (monthly rose), *Ligustrum japonicum*, and *Aucuba japonica*. At intervals along the hedges are placed examples of the trees and shrubs indigenous to or commonly grown in England. This arboretum (presented by Mr. Proctor) is intended to familiarise learners with the names and appearance of the common specimens which they are likely to meet with. Every tree and shrub has a conspicuous label attached to it, bearing the English and Latin name, the natural order, and the native country of the specimen. There is an extensive rockery on the terrace in the garden, now completely stocked with Alpine plants, and a number of rare Pyrenean plants, obtained by purchase from Chevalier Bordère in November 1871. The collection of Saxifrages is good and flourishing. The herbaceous plants are disposed in the plots of ground, and they are grown in narrow parallel beds, with strips of grass border between. They are, of course, arranged according to the natural system, a large label indicating the limits of each order, while a smaller one is placed beside every plant. Aquatic plants are grown in large pots filled with water and sunk in the ground: a sorry substitute, however, for a pond, and it cannot be expected that the collection of aquatics can either be adequate or well grown till some pools are formed for the special reception of this important division of plants. There are at present about 1,000 or 1,200 species of flowering plants, but some of the genera (and even orders) are poorly represented, while of others there are too many. But, when it is remembered that the garden is of recent formation, the progress made may be considered satisfactory. The curator has had great assistance in the determination of the different species of plants from his friend, Mr. G. C. Churchill, and both here and in the Museum he has never found lack of ready help among the boys of the college, for whose especial benefit both institutions have been formed.

When the various collections are a little better developed, the curator hopes to issue descriptive catalogues, which he thinks will make their utility much greater. The first of the series is to form a guide to the Botanic Garden, and it will be shortly followed by others on the minerals, shells, and insects in the Museum.

The curator thus concludes his report:—"It remains "that I should say how urgently we require further con- "tributions, not only of money, but of specimens. It will "give me great pleasure to communicate with intending "donors, and all gifts will be duly acknowledged at the "Scientific Society's meetings. The following is taken "from a circular recently issued. It will give a general idea "of our requirements:—

"CLIFTON COLLEGE MUSEUM.—*List of Desiderata. British Fossils*, with *name* (and, if possible, locality).—Those from the Palæozoic formations, and *local* specimens specially desired.

"*British Rocks. Named.*—Any good typical specimens.

"*British Minerals.*—A few good ones *only*, the collection containing already nearly 1,000 specimens. The sub-curator (J. G. Greenfell, Esq., Clifton College), will be glad to furnish mineralogists with the names of those most needed.

"*British Shells.*—Only the rare ones now wanted.

"*British Crustacea and Echinodermata.*—Any. We have very few.

"*British Lepidoptera.*—The sub-curator (Rev. J. Greene, Apsley Road, Clifton) still requires a considerable number of specimens, but the commoner ones have nearly all been supplied.

"*British Coleoptera.*—We have a large collection already, which has not been as yet fully arranged.

"*British Diptera and Orthoptera, &c.*—Any.

"*British Eggs.*—Information can be had of the sub-curator, D. Pearce, Clifton College. Many more eggs are needed.

"*British Birds.*—The nests of British birds are desirable, and a considerable number of stuffed birds.

"*British Mammalia.*—Skins or stuffed specimens of any found wild in Britain.

"*British Plants.*—The herbarium now contains more than a thousand species, but good specimens of rare or local plants would be highly acceptable.

"*British Coins.*—Any provincial tokens of the 17th and 18th centuries are also needed.

"*British Antiquities.*—Celtic, Roman, or early English remains. Many persons would probably be able to assist in the formation of this collection, which is as yet very small.

"*Zoological Series.*—Foreign specimens are here admissible; but, as *types* only of the principal natural divisions are required, it is desirable that the curator should be consulted before any such specimens are forwarded.

"*Osteology.*—The skeletons of the perch, frog (or toad), snake, pigeon, echidna (*Ornithorhynchus*), cat, rat, mole, bat, monkey, skulls of the pike, crocodile, tortoise, turtle, lizard, any large birds, any marsupials, sloth, armadillo, anteater, dolphin, hyrax, lion, tiger, bear, seal, walrus, monkeys. Separate vertebræ and other bones of fish, crocodile, any large birds, carnivora, &c.

"*Scientific Books.*—These are much required, especially such illustrated works on Natural History, Geology, and Botany, as would be useful for reference."

RUGBY SCHOOL.

At Rugby there is also a Museum containing a very fine collection of geological specimens, a large portion of them being local, and collected by members of the school; also a good collection of minerals and numerous rock specimens.

The following description of this Museum has been furnished by Mr. Wilson :—

History.—The origin of the museum was a collection of common stones from various parts of England brought to the school by the boys at Dr. Arnold's request. These were placed in cases, in many instances without names, or localities, or arrangement. Subsequently, two of the assistant masters, the Reverend C. T. Arnold, and the Reverend H. Highton, arranged and catalogued such of these as could be identified, and added to the collection some specimens of rocks and fossils obtained by purchase.

Rooms.—The rooms at present available for collections to illustrate Natural History are a part of the Arnold library, and a small room belonging to the Natural History Society.

Geological Museum.—In the Arnold Library are placed the geological collections. These consist of (1) a *local collection* of *Lias fossils* and *Drift stones*, which has gradually accumulated under its present Curator, Mr. Wilson, partly from the gifts of collections made by the boys. A list of this collection has been published in the R. S. N. H. Society's Reports.

There is also (2) a *general collection of fossils* arranged stratigraphically in a series of glass cases, with drawers underneath, which is sufficiently complete as regards characteristic fossils, for elementary geological teaching. It contains, however, but few *fine* specimens, being the result not of purchase but of amateur work in various parts of England. Among donors to this collection, besides the present Curator, may be named Mr. J. R. Allen, Reverend T. G. Bonney, Mr. W. H. Dutton, Mr. S. G. Perceval, Reverend T. A. Preston, Reverend C. S. Taylor, Mr. G. H. West.

There is (3) *a collection of rocks* formed by the present Curator, partly by purchase. This has been lately arranged by Mr. F. C. Houghton, in a series of shelves behind glass, according to the arrangement of Cotta. This collection is also fairly adequate for the elementary teaching of Geology.

Lastly (4), there is a *collection of minerals and ores*, made from various sources, which has been arranged by the Reverend T. N. Hutchinson, for the most part on a chemical basis. The collection, though very incomplete, must be regarded as adequate to its present use in teaching.

A collection of photographs, sketches, and diagrams has been made by Mr. Wilson, and is found of the greatest use in geological teaching. Some microphotographs have been presented by Reverend H. H. Higgin.

A model of the neighbourhood, on a scale of 6 inches to the mile, is in process of formation.

Botany.—In Botany the school possesses a herbarium of British plants, collected by Mr. Kitchener. There is also a special local collection of plants. It being found that a herbarium in its usual form is of hardly any use to a school, as only a few boys can be trusted to have admission to it freely for reference, the local collection is in course of transference into large note books, where they will be securely fastened, and replaced from time to time if injured.

Various collections have been also presented. British ferns by Mrs. Gray; Canadian and other plants by Mr. Moberly; British plants by Mrs. Phillpotts (many plants in this collection were collected and named by the late Miss Warren). British Rubi and Salices by Reverend A. Bloxam; New Zealand plants by Mr. Reid of Otago. The school also possesses the series of drawings and specimens illustrative of the natural orders prepared by Mr. Oliver of Kew, and a considerable number of other diagrams on botany.

Zoology.—In Zoology we have a valuable series of *dissections* illustrating the comparative anatomy of the animal kingdom, and specially adapted to Dr. Rolleston's "Forms of Animal Life." The preparations were arranged by Mr. C. Robertson, Demonstrator of Anatomy in the Oxford Museum, and are duplicates of the original Oxford series. They were presented by Mr. G. H. Morrell, late Assistant Demonstrator at Oxford.

A small collection of *skulls and skeletons* of local mammalia, and a collection of birds' eggs have been commenced by the Natural History Society. There is a small collection of *shells* of land and marine mollusca.

The Insect Collections.—There is at Rugby a collection in process of formation of all the *British Lepidoptera.* Three smaller collections made in various parts of England, and presented to the school, were united together and made the basis of one general collection. This is increased from time to time by boys who collect for it, besides presents from those who have left and who still keep up the study. In the cabinet all those species which are found at Rugby (none but well authenticated captures being recorded) are marked with a letter in red ink, so that the local species may be distinguished at a glance. It is hoped that in time this may be made a fairly complete collection for purposes of study. Any remarkable varieties are especially preserved and placed close to the ordinary specimens of the species.

From time to time presents are made to the museum of cases of foreign insects, but not hitherto on a large enough scale, nor generally in a sufficiently satisfactory state of preservation, to make it worth while to attempt anything like an European collection even of a limited group or number of families. For purposes of study, that is, speaking more precisely, for the observation of the general characteristics of groups, and the shades of difference by which they gradually diverge, the most instructive method would be to form an European, or even an universal collection of one or more small groups, as, for instance, certain well represented and widely distributed families of butterflies: and it is hoped that something of this kind may in future be attempted.

No attempt has yet been made to study any groups of insects except the Lepidoptera. The chief cause of this deficiency is the absence of any cheap or accessible text book on the other orders. But as time goes on, and the Lepidoptera cabinet is filled, it would certainly be desirable to extend the collection to the other orders, at least to the Coleoptera and Hymenoptera.

The whole of the work in this department has been done by the Natural History Society, entirely apart from any school work.

Desiderata.—The teaching of all branches of Natural History at Rugby has been much influenced by the fact that the school possesses no better museum than the small and partial collections above described; for there can be no satisfactory teaching of zoology, nor even of geology, without a zoological collection. When these subjects take a higher place in school education, and are taught by men who have themselves had the advantage of the use of museums, the present state of things will not be tolerated. Among our desiderata must be mentioned, in the first place, a proper room for a museum. This it is hoped may be found ultimately in the Arnold Library. When the Temple reading room is built, the Arnold Library will be available for a museum and library of books on special subjects, such as the natural sciences and antiquities. It is large enough for both these subjects, at any rate for some years to come, and is a room suitable for a museum, but unsuitable for a reading room or library. But the establishment of such a museum of geology and zoology as would be of real use in school teaching involves considerable expenditure on specimens, on diagrams and printing, and on proper cases for the specimens. And, moreover, no museum would be of much use unless there was a curator in constant attendance, and this costs more money. The masters have far too much to do to attend properly to the ceaseless work that the care of a museum involves; and a museum only accessible to boys when a master can afford time to be present would be in practice almost useless. Nor can a museum at school be thrown open to all, without the presence of a curator. Accidents are sure to happen, and the result is endless annoyance.

It is probable that the true functions of a museum at school have yet to be discovered, but it cannot be doubted that in Classical Antiquities and in Natural History a museum is essential if the boys are to know things at first hand, and when such a museum exists its use will speedily follow. It is not necessary that it should be large, but it is necessary that it should be well selected. The ordinary museum of the present or past day, consisting of two or three bottles of snakes, a stuffed alligator, and two Burmese idols is not instructive, and is not the ideal to be aimed at. Rigorous exclusion of mere miscellaneous curiosities must be the law of the museum.

A larger room is wanted for the use of a Natural History Society, for preparing specimens, &c., for the museum; but it will not be difficult to supply this want.

Among other desiderata must be mentioned a botanical garden, in which the local plants may be arranged in their orders. It is possible that when the new observatory is built, and it is only a question of site that is causing delay, some part of the ground surrounding it may be made available.

The present writer cannot help expressing his hope that a museum will not long remain a desideratum. A collection sufficient for all school uses could probably be purchased and properly exhibited for 2,500*l.*; and it will be strange if among the wealthy and loyal old Rugbeians some one is not found who will by such a gift perpetuate his name as an enlightened lover both of science and of the school.

At Cheltenham College there is a Museum, partly scientific in contents and arrangement, and there is a botanical garden of half an acre. The museum is barely three years old, the botanical garden just 12 months.

At Taunton College School there is a Typical Museum and a Botanic Garden.

At Marlborough School there is a Museum and a Botanic Garden.

At Dulwich College the formation of a Museum of Natural History has been lately commenced.

At Winchester College there is a room for a Museum and for the use of boys who collect objects of Natural History.

§ 14.—SCHOOL SCIENTIFIC SOCIETIES.

At all the Schools I visited in connection with which Natural History Societies have been established, I was so fully assured of the value of these organizations in developing a spirit of inquiry and observation among the boys, that I have brought together here the Rules of several of the Societies which are already at work.

Rugby School.

The Rugby School Natural History Society was founded in 1867, and at the present time (October 1872) consists of nine honorary members (chiefly masters of the school), 39 corresponding members (chiefly old pupils), 15 members (present scholars, who have been elected full members for work done), and 62 associates (present scholars not yet promoted to full membership). The society at present comprises nearly one fifth of the school. It is worked by public meetings (held once a fortnight), at which objects of interest are exhibited, and papers (by masters or boys) are read; by sectional meetings of boys having similar tastes, as, for instance, the botanists, the geologists, the microscopists; next, for work or discussion, by occasional (though necessarily rare) excursions from Rugby, the places visited during the year 1872 being Charnwood Forest and several factories at Birmingham; and by the use of a special room to which the members of the society alone have access. In this room are kept collections of insects, plants, &c., dissections and skeletons arranged for study, and a library of books on natural science is being formed for reference. A report of the proceedings of the society is published annually at Rugby. The society is found to have an influence for good on the boys. The meetings show that the society is popular, as there are generally from 70 to 100 present; but as yet great difficulty is found in getting the boys themselves to take part in the meetings, whether by reading papers or sharing in the discussions; hence it is believed that greater real good is done by the smaller sectional meetings. The society is found to be very valuable in bringing forward any boy who has a speciality, which, in the hurry of school work, might have escaped notice. Such a boy is found out either by being introduced by his friends or by asking questions, and the president then introduces him to the other boys in the school who have kindred tastes, and brings him under the notice of the master who has charge of his favourite subject. It is found that the boys are delighted to be of any use, and will undertake any scientific drudgery that may be suggested to them, provided they are assured that it will do some good. Some good work is done in recording meteorological observations and floral dates, and in making sketches of striking or interesting geological sections, &c.

The rules of this society are as follow :—

1. That this society be called "The Rugby School Natural History Society."

2. That the society consist of honorary members, corresponding members, members, and associates.

3. That masters, and others connected with the school, be eligible as honorary, and old Rugbeians as corresponding members; that present Rugbeians (having attended as a visitor three of the societies meetings) be eligible—if in the upper school or sixth, as members, if in the middle or lower school, as associates.

Of Officers.

4. That the society's officers consist of a president, secretary, and treasurer, and of the keepers of the several albums, and that these do form the committee of management, three to be a quorum.

5. That all officers be elected annually.

6. That when any office is vacant, the committee do recommend a member or associate, or (for the office of president) an honorary member, for election by the members of the society, and that the election be by scrutiny.

7. That the president take the chair at all meetings, but have no vote except in cases of equality.

8. That the secretary keep the minutes of the society's proceedings; keep a list of all persons present at each meeting; keep a list of the existing society, with the names and addresses, as far as possible, of all corresponding members, and a list of all benefactors of the society.

9. That the president and treasurer form a sub-committee for managing the finances and keeping the property of the society.

10. That the duty of the several album keepers be to receive all notices connected with their several sections, to enter all occurrences of interest in their album, and at the end of each year to furnish a report of what has been done in his section during the year.

11. That in the absence of any officer the committee appoint a deputy.

Of Honorary and Corresponding Members.

12. That honorary members be elected by open vote of the society; pay an entrance fee of 10*s*., but no subscription unless specially called upon; and have all the privileges of members, except that of voting.

13. That corresponding members be elected by open vote of the society, without entrance fee, and have all the privileges of members, except that of voting; but be required to pay for the society's reports, for a supply of which they may pay a composition of 10*s*. for six years.

14. That members or associates, on leaving the school, become corresponding members without election.

Of Members and Associates.

15. That members and associates be proposed by a member or honorary member and elected by the committee.

16. That there never be more than 20 members, or more than 20 associates.

17. That members and associates pay a subscription of 2*s*. 6*d*. per term, and that any member or associate who shall, at the beginning of any term, be reported by the treasurer as not having paid his subscription for the last two terms be struck off the list of the society.*

18. That members may speak at all meetings of the society; may read papers with the leave of the president; may introduce four visitors at all public meetings, and receive a copy of the society's report.†

XIX. That associates have the same privileges as members, except the right of voting at private meetings of the society.

XX. That associates, on reaching the upper school, do not become members without election by the committee.

XXI. That any member or associate may be suspended or expelled from the society by a vote of two-thirds of the members present, if he, from any misdemeanour or want of energy, appear to deserve such suspension or expulsion.

Of Meetings.

XXII. That ordinary meetings be held once a fortnight, but that the secretary be empowered to call extraordinary meetings when necessary.

XXIII. That visitors may speak and read papers at all public meetings, with the leave of the president.

---

* Subscriptions are allowed by a school rule to be charged in the school bills, as soon as a note has been brought to the President, signed by the boy's tutor, to the effect that leave from home has been obtained.

† In consequence of the loss incurred on the sale of the last report, the gratuitous supply of copies of this report has for the present been suspended.

Of Reports.

XXIV. That a report be printed once a year, or oftener if the committee think fit.

XXV. That an editing committee, of two members and one honorary member, be appointed by the president for each report.

Of New Rules.

XXVI. That without notice given at the preceding meeting no change can be voted in these rules, or any name be submitted to the committee for membership or association, or any vote of suspension or expulsion passed.

XXVII. That no change be made in these rules, unless proposed by a member or honorary member and carried by the votes of two-thirds of the members present.

CLIFTON COLLEGE.

The Clifton College Scientific Society, which was founded on the 25th of June 1869, is managed by the boys themselves and one or two of the Science Masters. "This "society holds fortnightly meetings, at which scientific "papers are read and discussed, objects illustrative of "natural history are exhibited and explained, and so forth. "A record of its proceedings is kept by the secretaries, the "first and second volumes of which have been printed. "The number of boys who can belong to it is limited to 70, "and the interest excited by it in the school is so consider- "able, that there are regularly a number of boys waiting "their turn for election."

The Science masters and the students are at present engaged in the formation of a museum, which they are making of a strictly educational character, *i.e.*, admitting nothing but what contributes directly to its educational value; they are also stocking a moderate-sized botanical garden with typical specimens of plants, which will materially help the study of botany; and they are about to set up an apparatus for meteorological observations.

In all this the aim has been to make the boys themselves the chief agents, only advised, directed, and assisted by the Science Masters, and one or two scientific neighbours who take a warm interest in these matters.

Thus the Natural History Master is President of the Scientific Society, and curator of the museum and botanical garden; but for everything connected with their management he has associated with him committees of the boys, made up of those most prominent in these subjects.

A new feature in the constitution of the society deserves especial notice: "In February 1871 it was proposed to "found 'sections' for the study of certain sciences, and as "the plan met with a ready acceptance at the hands of the "society, seven of these sections have been formed, and are "now in full working order. They are as follow: botany, "geology, zoology, entomology, chemistry, physics, and "archæology. A 'director' of each section is nominated "by the society, and some one is appointed by him to "keep the records, &c., with the title of 'sectional secre- "tary.' Not more than 10 members are admitted into "each of these companies, and although it is not abso- "lutely forbidden to join more than one section, it is at "the same time discouraged, for the committee believe "that the best members of sections will be those who do "not distribute their energy over many varied subjects. "The president and secretary of the society are *ex officio* "members of every section, and may attend the meetings "when they please. In this way the sections are brought "into close relation with the governing body of the society "at large. It is left to the director to summon the mem- "bers together at such times as may suit general con- "venience, and, indeed, he is allowed to manage the "section as may seem to him best, subject only to the "control of the General Committee. In most sections "there are both evening meetings and excursions. "Scientific journals are taken in and circulated, sectional "libraries are being formed, and the geological adherents "have already begun to make a collection of local fossils "found by themselves. So far the scheme works admi- "rably, and it is hoped that when the next volume of "*Transactions* is issued a favourable report will be given "from each one of the seven sections."

"I have dwelt," the Head Master observes, "upon this "voluntary and extraneous part of our scientific work, as "distinct from our school teaching, because it would "otherwise have been impossible to give a correct idea of "the influence of science in the school; and, moreover, I "attach great importance to this voluntary work, and "should wish to see it encouraged and fostered in all "schools."

The society "has exercised a valuable influence by "stimulating the taste and intellect, and giving much "enjoyment to many boys who would otherwise have lived "a very obscure and dull life in the school, whilst it has "also been of use in helping to give something of an "intellectual tinge to the ordinary intercourse and conver- "sation of the boys. Such institutions prevent the "athletic side of school life from becoming too exclusively "predominant."

The rules are as follow:—

1. That this society be called the "Clifton College Scientific Society."

Constitution.

2. That the society consist of ordinary, corresponding, and honorary members.

Officers.

3. That the officers of the society consist of a president, secretary, treasurer, and three members of committee, to be elected from and by members of the society, with the exception of the secretary, who shall be chosen by the committee from their own number. All officers, excepting the president, to be elected terminally.

Management.

4. That the affairs of the society shall be conducted by the above officers.

Secretary.

5. That the duties of the secretary be, to keep a list of all the members of the society, and of all former members and benefactors, who may wish to receive the transactions of the society; to give notice of meetings, and to keep a detailed report of the proceedings as well as lists of members and visitors present at each meeting. In the absence of the secretary, the president may appoint any member of the committee to take minutes of the proceedings.

Treasurer.

6. That the duties of the treasurer be, to collect all sums of money due to the society, to receive all donations of money, and to disburse all sums of money payable by the society out of the funds entrusted to him.

That the treasurer furnish half yearly a detailed account of the receipts and disbursements, to be audited by the committee.

Members.

7. That the number of members be 70, of whom 10 shall be elected from the junior school.

That ordinary and corresponding members shall be proposed and seconded at a meeting of the society, and elected at the meeting next following. Less than three fourths of the votes of the members present to exclude any candidate.

That honorary members shall be elected by the committee.

That a subscription be payable terminally (the amount to be fixed by the committee), but in no case to exceed 2*s*. 6*d*. for the upper and 2*s*. for the junior school.

That all subscriptions must be paid between the first and second meetings of the term, and that any member retiring from the society be required to pay all subscriptions due.

That, under penalty of expulsion from the society, all members be required to attend two thirds of the ordinary meetings in each term, except for reasons deemed sufficient by the president. Attendance at extraordinary meetings to be optional.

That a certain number of tickets for admission to ordinary meetings shall be issued by the president for collegians who are not members of the society, but that on application being made to him, any member may introduce other visitors.

Sections.

8. That sections be formed for the more accurate study of the different branches of science, and that the directors of these sections be chosen by the society.

That the sections shall hold meetings as often as may seem fit to their respective directors, at which any members of the college, with the sanction of the director, may attend.

Meetings.

9. That ordinary meetings of the society be held once a fortnight, but that the president be empowered to call extraordinary meetings at his discretion.

New Rules.

10. That any member of the society have power to propose any new rule, or any alteration in an old one, provided the motion be seconded by another member, and that notice of at least one week be given to the secretary.

MARLBOROUGH COLLEGE.

A Natural History Society in connexion with Marlborough College (the earliest, it is believed, that was founded at any public school) was established in April 1864, when two or three members of the school, who had a taste for natural history, banded themselves together, electing the Rev. T. A. Preston, one of the masters, as their President, and agreeing to meet on certain nights for consultation. At first difficulties cropped up thickly, but scientific energy, aided by the firm support of the Rev. G. G. Bradley (the late Head Master), in time overcame these. The society grew, and a year and a half after its formation published its first report. The career of the still small but thriving society brightened more and more. About the middle of 1866 the College provided a room as a museum.

From that time to this no cloud of any importance has appeared on the society's horizon. It now publishes its reports half-yearly, numbers more than 50 members, and its collections have outgrown its museum. One of the masters, as already mentioned, is president; other masters frequently attend and read papers. There are fortnightly meetings, at which papers are read, very often by the boys themselves. There are various sections (geological, botanical, entomological, archæological, &c.), each of which is presided over by one of the members, and which furnish quarterly or more frequent reports. There are one or two field-days every term; on these days the boys go to explore new districts beyond the reach of an ordinary walk.

The papers read at the meetings of the society are published half-yearly with the Report, and in addition, a *Flora of Marlborough*, two portions of which have appeared. This is a second edition of the *Flora* by the Rev. T. A. Preston, which first appeared in 1863, differing, however, very materially from it, principally in containing short descriptions of the different species.

One result of the formation of this society has been the production by a Marlburian (Everard F. Im Thurn) of a work on the *Birds of Marlborough*, in the preface to which the author says: "It is only now, when I feel at last "forced to render an account of the work which I have "undertaken and have now completed, that I feel its many "deficiencies. I have, however, one consolation: I feel that "I have done my best to render a tribute of gratitude to "the school, where I passed so many pleasant hours, and "to the Natural History Society of that school, to which, "and to which alone, I owe the formation of tastes which "now prove a continual and endless source of pleasure "and occupation to me."

The present Head Master states that "the influence of "this society on the boys is in all respects most valuable, "and the extent of practical work which it has effected "may be judged by the long series of published reports, "as well as by the Flora of the district, and full accounts "of its entomology, geology, ornithology, &c., it has "produced."

The rules are as follow:

1. That this society be called the Marlborough College Natural History Society.

2. That it be managed by a committee of five members, and that the vacancies in the committee be filled up by persons elected from and by members of the society.

3. That, in the absence of the President, one of the committee take the chair at the meetings.

4. That the election of new members rest with the committee.

5. That any one may be elected a member of the society, if he have attended as many meetings, and have shown as much interest in the proceedings as the committee shall think fit; and that the names of such new members be read out at the next meeting after the election.

6. That each member be allowed to bring one friend to the meetings of the society, and that his friend be allowed and requested to enter into any discussion, or show any object of interest, but be not allowed to vote on any question.

7. That each member be responsible for the behaviour of his friend.

8. That the meetings of the society be held once a fortnight.

9. That the committee be empowered to eject or suspend any member if, without good reason, he absent himself twice in succession from the meetings of the society, or be judged guilty of any serious misdemeanor at such meetings.

10. That any person present may exhibit objects calculated to interest the society at their meetings.

11. That it be left to the committee to determine the subjects for lecture or discussion, and that any person may deliver a lecture before the society with the sanction of the committee.

12. That in case of an equality of votes, the casting vote lie with the President, and that he have no vote except in such a case.

13. That a report of the proceedings of the society be entered in a book, to be kept for that purpose by the secretary.

14. That the secretary be chosen out of the committee by the members of the society, and that he hold office for one half year, but may offer himself for re-election at the commencement of the next.

15. That any member of the society have power to bring forward a motion for the alteration of any rule, provided his motion be seconded by another member; and that the making of new rules shall lie with the committee, who shall not have power to alter them without the consent of the majority of the society.

WINCHESTER COLLEGE.

A Natural History Society has been started in the school, to encourage boys to collect specimens, and to communicate with one another about them. It is limited to 50 boys, who adopt the members. It meets once in three weeks, and two of the masters help to manage it. The boys have shown that they are interested in the objects of the society; they have read papers, and have made creditable collections of plants, shells, insects, fossils, and minerals. Prizes have been given at different times for such collections by the Head Master and one of the assistant masters, but the Head Master considers that the boys collect as well for themselves without prizes. Gradually a museum and library are being formed (one of the class rooms being given up for the purpose), and sets of apparatus are being procured; but these are works of time, and are not yet far advanced.

This society has, in the opinion of the Head Master, given a number of boys an interest which has been quite real and good. Mr. Griffith, one of the masters, has created a considerable geological interest amongst some of the boys.

The Head Master looks forward to the time when a laboratory can be established (there being at present no means of teaching chemistry except by lectures), and also a botanic garden.

WELLINGTON COLLEGE.

A Natural History Society in connexion with this College was founded early in 1868, through "the efforts of one or "two of the masters, and any success which may have "attended it during the first year of its existence is due "in a great measure to them." The meetings, which are held once a fortnight, have been numerously attended; the members, numbering about 20 boys, have the power of introducing others to the lectures. The average attendance at the meetings is 30 or 40 (often the number is larger), and various interesting papers, contributed by the boys themselves, have been read, on mosses, hawks, photography, fortification, electricity, snakes, manufacture of alum, and the natural history of man. The botanical, entomological, and zoological departments have met with a fair success; but Wellington College is very unfortunately situated in a geological point of view, few fossils and objects of geological interest being found in the neighbourhood. Professor Kingsley and Professor Rupert Jones have taken great interest in the society, and, as well as other friends and some of the masters, have frequently delivered lectures and addresses. Two reports have been published at intervals of about 18 months, and accounts of the meetings appear in the School Magazine.

The rules of the Society are as follow:—

1. That this society be called the "Wellington College Natural History Society."

2. That the society consist of honorary members, corresponding members, 15 members, and 20 associates.

3. That all members of the school having attended three meetings of the society be eligible as associates, and that members be chosen from among the associates.

4. That the society's officers consist of a president, secretary, and treasurer, and of the keepers of the albums of the four departments.

5. That the officers do form a committee of management, and that the committee be empowered to invite not more than two honorary members to join them in their meetings. In meetings of the committee, four to be a quorum.

6. That all officers be elected annually—the president from among the honorary members, the others from the members.

7. That the president take the chair at all the meetings, but have no vote except in cases of equality.

8. That the secretary keep the minutes of the society's proceedings; a list of all persons present at each meeting; a list of the existing society, with the names and addresses, as far as possible, of all honorary and corresponding members; and a list of all benefactors of the society.

9. That the treasurer look after the property of the society, collect subscriptions, and pay debts, producing his accounts whenever called upon by the president to do so.

10. That the duty of the several album keepers be to receive all notices connected with their several sections; to take care of the collections; to enter all occurrences of interest in their albums; and at the end of each year to furnish a report of what has been done in their sections during the year.

11. That in the absence of any officer the committee appoint a deputy.

12. That honorary and corresponding members be elected by a vote of the society, and have all the privileges of members except that of voting.

13. That honorary members pay an entrance fee of 10*s.*, but pay no subscriptions unless specially called upon.

14. That members or associates, on leaving the school, become honorary members without any charge, except for a supply of the society's reports.

15. That members and associates be proposed by a member or honorary member, and elected by the committee.

16. That members pay a subscription of 1*s.* 6*d.*, and associates of 1*s.* per term.

17. That members may speak at all meetings of the society; may read papers with the leave of the president; may introduce one visitor at all public meetings, or if on the committee, two; and receive a copy of the society's report.

18. That associates may speak at all public meetings, and read papers with the leave of the president, and receive a copy of the society's report, but not have the privilege of introducing visitors.

19. That members provide with tickets the visitors whom they introduce at any meeting, and that no visitors, except those introduced by honorary members, be admitted to any meeting of the society without such a ticket; but that in special cases the committee be empowered to issue extra tickets.*

20. That any member or associate may be suspended or expelled from the society by a vote of two-thirds of the members present, if he, from any misdemeanor or want of energy, appear to deserve such suspension or expulsion.

21. That ordinary meetings be held once a fortnight, but that the secretary be empowered to call extraordinary meetings when necessary.

22. That visitors may speak and read papers at all public meetings, with the leave of the president.

23. That without notice given at the preceding meeting, no change can be voted in these rules, or any name be submitted to the committee for membership or association, or any member or associate be suspended or expelled.

24. That no change be made in these rules unless proposed by a member or honorary member, and carried by a majority of the votes of the members present.

CHELTENHAM COLLEGE.

At this College there is a Natural History Society, consisting of 10 of the masters (of whom three are working members), and 40 boys. The secretary is a boy. The meetings are held weekly or fortnightly during the winter six months; and in summer there are fortnightly excursions. Subscription, annual, 3*s.*, with entrance fee, 2*s.* 6*d.* The influence is found to be good decidedly; but it does not act on a large number of the boys.

ETON COLLEGE.

At Eton there is a Literary and Scientific Society, managed by the boys, and the members elected by them. The members read papers, and a discussion takes place. Occasionally lectures are given by persons not resident at Eton, by invitation of the Society.

HARROW SCHOOL.

Of the Harrow School Scientific Society, meetings are held about once a fortnight. Papers are read by the members, or, occasionally, by strangers. It is almost impossible to estimate its influence on the boys generally. The members themselves undoubtedly receive benefit from the papers, and the discussions which follow. The society also exercises good influence on those who make botanical and other collections. The rules of the society are appended.

1. That the Harrow School Scientific Society consist of members, honorary members, and associates, who take sufficient interest in scientific pursuits to guarantee their steady assistance in carrying out the objects of the society.

2. That the honorary members of the society consist of those masters who express a desire to join the society, and others who may be elected by the society.

3. That ordinary members, not being below the fifth form in the school, be elected by ballot, after having been duly proposed and seconded at the previous ordinary meeting; one adverse vote in three to exclude.

4. That each member pledge himself to contribute in his turn, or when required by the committee, a paper on some subject connected with science.

5. That each member, or resident honorary member be allowed, with the consent of the committee, to nominate, as an associate, any one boy not below the remove: and any member of the committee, two such associates.

6. That the president be allowed to nominate as many associates as he shall think fit, from any part of the school he may think desirable.

7. That such nominations only continue in force for one school-term; but that any boy, after three successive nominations, becomes, *ipso facto*, an ordinary member.

8. That associates shall not be liable to read papers before the society, and shall have no vote on questions of administration, but shall be allowed to attend any of the ordinary meetings.

9. That each resident honorary member, ordinary member, and associate, pay an entrance fee of 1*s.*; and that the subscription for each term be 2*s.* 6*d.* for each member and resident honorary member, and 2*s.* for each associate, which is to be paid to the treasurer at the first meeting of the society in each term, at which meeting the treasurer shall lay before the society an account of all expenses incurred.

10. That the affairs of the society be conducted by a president, vice-president, secretary, and treasurer; and by a committee consisting of these officers, the ex-president, and six ordinary members of the society; four members of the committee, of whom one at least shall be an officer, to form a quorum.

11. That the president and vice-president be appointed by the committee, annually, at the end of the summer term, or in the event of the resignation of either before that period, from among the masters who shall be honorary members of the society.

12. That it be the duty of the committee to propose at the last meeting but one of the summer term, members to fill the offices of secretary and treasurer, and the other vacancies in the committee for the following year; and that it be competent for any member at the same meeting to propose other candidates, whose names, if duly seconded, shall be submitted to the society, together with those of the nominees of the committee, for election by ballot at the next meeting.

13. That any vacancy in the committee, or in the office of secretary or treasurer, occurring at any other time than at the end of the summer term, be filled up in like manner by a nomination at the ordinary meeting next following such vacancy, and by election at the next succeeding ordinary meeting.

14. That the committee be competent to fix the times of ordinary meetings, and the papers to be read at each, and to authorize the expenditure of funds; but that all rules affecting the constitution of the society must be passed by a majority of those present at an ordinary meeting.

15. That any member, on giving notice to the secretary, be permitted to introduce a friend.

16. That any member or associate of the society who absents himself from two consecutive meetings, without giving some reason to the president, shall pay a fine of 1*s.*

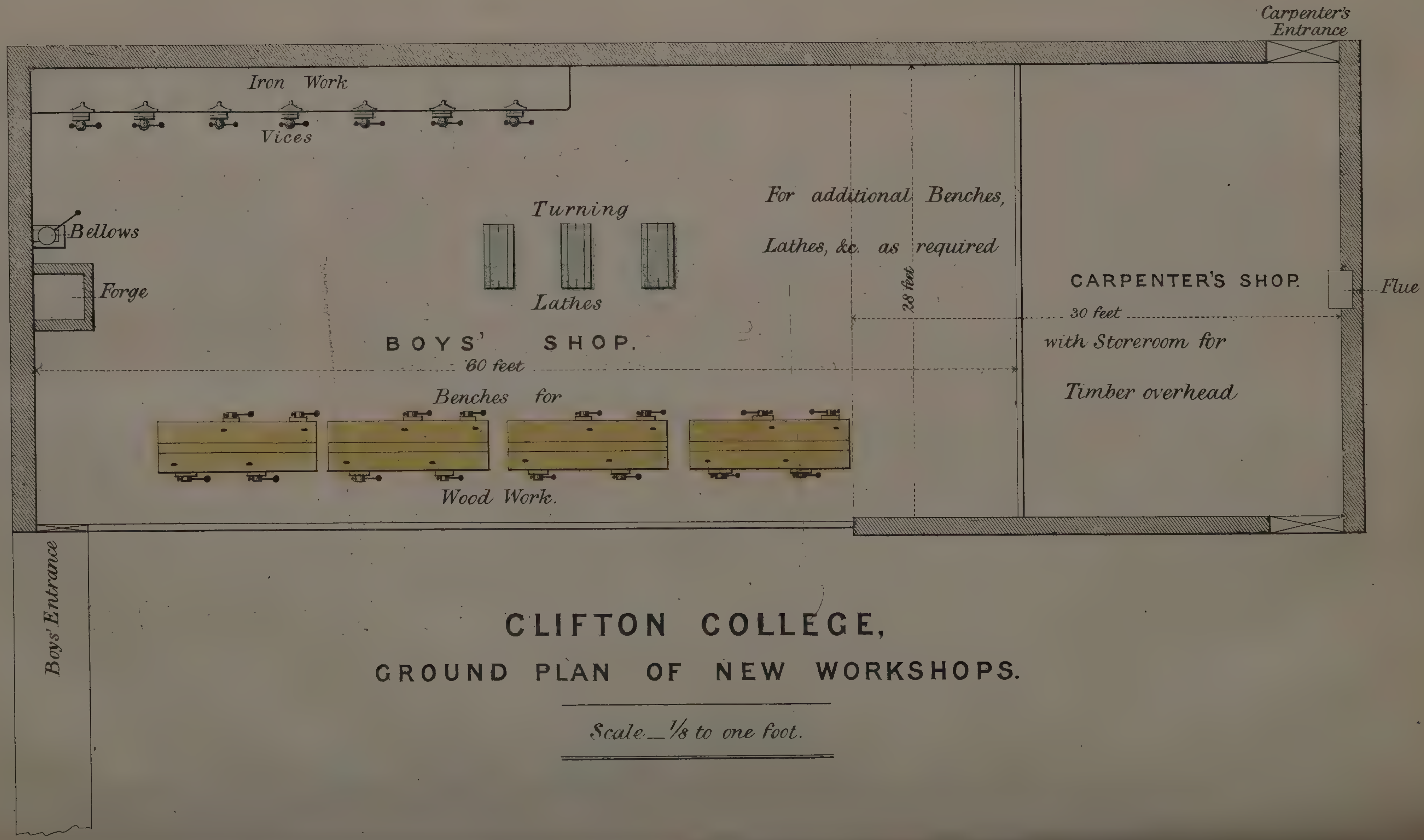
17. That every member on joining the society, sign the following declaration:—

"I hereby promise to conform to the rules, and to give my best assistance in carrying out the objects of the Harrow School Scientific Society, so long as I continue a member of the same."

18. That the members and associates endeavour to exhibit, at each meeting of the society, some object of scientific interest.

---

* This was not one of the original rules.



CLIFTON COLLEGE,

GROUND PLAN OF NEW WORKSHOPS.

Scale—⅛ to one foot.

19. That the objects of the society be: To record scientific observations; to promote the formation of a Harrow School museum of natural history; and to encourage, by offering prizes or otherwise, the pursuit of science in the school.

MANCHESTER GRAMMAR SCHOOL.

The Manchester Grammar School Philosophical Society was established in 1869. It is composed of the boys of the sixth and other science forms; its officers are elected from among its members by ballot; it meets every Friday, after school, for the reading and discussion of scientific papers, written by its members; the subscription is 2*s.* entrance fee, and 2*s.* 6*d.* per term. There are three terms per annum. The society is considered to be decidedly useful in promoting scientific reading and thought among the members.

---

§ 15.—WORKSHOPS.

There are workshops in full operation at King's College School, Clifton College, and Rossall School. At Marlborough, Rugby, and Taunton, where, up to the present time, there are no school workshops, it is stated that buildings will shortly be erected or utilized for that purpose. At Taunton it is contemplated to provide for turning, casting, and modelling, and for microscopical mounting. At Marlborough there is a workshop close to the college, fitted up by a tradesman in the town, and boys are encouraged to learn turning, &c., under his guidance. At University College School, and at Manchester Grammar School (where its absence is much felt), there is no workshop.

Of the three first-named workshops that at King's College, for the joint use of students at the college and school, is the most extensive, being furnished with steam-engine and planing machine, and it is worked on the most rigorous system. The building consists of two floors, the upper one for wood and the lower for metal work. The boys are first put through a course of wood work, after completing which they commence iron work, and construct lathes and small steam-engines and boilers and models of machinery of various kinds. The following more detailed statement, taken from the report, will give a better idea of what is actually done.

1. Students or boys of the first year, on joining the department, are made acquainted with the different tools, and their practical application to the purposes of carpenters' and joiners' work, by going through the processes of preparing the wood, setting out and forming, from figured drawings prepared by themselves, the various joints used in constructions of wood, after which they are employed in making models, in which the preceding joints are combined, so as to form trusses for roofs, bridges, girders, and other framing, required for buildings and other purposes.

2. Students are then enabled, in their third term, to proceed with the construction of models of various sorts, in illustration of the different apparatus used in practical mechanics, manufactures, and philosophical experiments, which involve the necessity of turning, for which purpose they are instructed in the use of tools for turning soft wood, hard wood, ivory, and other substances, and also in the mode of preparing and fixing the work in the lathe; the formation of cycloidal, epicycloidal, and involute teeth, for wheels, pinions, racks, &c. They are also instructed in the method of working in sheet metals and soldering.

3. Second year's students commence metal work, the operations of which consist of the various processes of chipping, filing, fitting, turning, boring, screw-cutting, and planing, the construction of foundry patterns in wood or metal and core-boxes.

These students are also instructed in forging wrought iron and steel, and in Easter term a moulder attends who gives practical instruction in the art of moulding.

4. With proper attention to the foregoing routine of procedure, the students become sufficiently proficient to be enabled to make for themselves lathes, and the apparatus connected with them, tools of various sorts, working models of steam-engines, boilers, and other machinery, in the construction of which either metal or wood, or the two combined, are employed.

The third year's students continue the second year's subject, and, in addition, they are encouraged to make experiments on the strength of arches, beams, and girders are constructed from working drawings made by the students themselves.

5. At the termination of the year a prize is given in each year, for proficiency in the execution of some piece of mechanism, the subject of which is given out during the Lent or Easter term.

In order to obtain a prize in either the second or the third year, the student is required to send in with his model or machine a finished form, dry pattern, with core-boxes, &c., of at least one of the castings used in such machinery or models, which pattern he shall himself have made, accompanied by working drawings of such machinery, also made by himself.

At the present time 39 boys attend. The regulated time for work is on Wednesday and Saturday afternoons, and no student is admitted into the workshops at any other hours without previous permission of the Dean of the Department, as well as that of the Superintendent, this sanction being only given on condition that the applicant is not thereby neglecting other duties in the college.

Every student is expected to furnish himself with a set of the simplest tools requisite for working in wood and metals. In order to diminish the expense of these tools as much as possible, the student may purchase them at the college; and upon his leaving they will be repurchased from him at a reduction depending on the condition in which they are returned. No student is allowed to obtain tools or materials in the workshop to a greater amount than 4*l.* in any one term, without the consent in writing of his parent or guardian.

The boys are provided with a dress for use in the workshop, and this tends greatly, not only to increase the business-like, real *look* of the place, but, I believe, to make the work itself more real and earnest.

At Clifton College the present workshop is 40ft. by 20ft., and both wood and metal work is done; it contains (1) four large carpenters' benches to accommodate 16 boys (2) eight vices, with steel chisels and other requisites for fitting, &c.; (3) a forge, with the necessary appliances; (4) three turning lathes, with one slide rest, for the turning of both wood and iron; but it is found insufficient, and a new one, of which a plan is given, consisting of one large room 60ft. by 28ft., is about to be built.

The object of the workshop is described in the report as being (1) to teach boys the use of all the common mechanical tools; (2) to give them some knowledge of different kinds of material, as wood, iron, &c.; (3) to teach them practical carpentering, fitting, turning, forging, &c.

At the present time about 50 boys take advantage of the workshop at Clifton, working in it at such hours as they can spare during out-of-school time, each boy paying a fee of 15*s.* a term, or 2*l.* 5*s.* a year, to cover the expenses of superintendence, instruction, and material.

Joining the workshop is quite a voluntary matter, and any boy can take home anything which he makes there.

The cost of the building, which is quite a plain one, and the fittings, tools, &c., was something under 250*l.*

The cost of material used, with wear and tear of tools, has been estimated at about 15*s.* per week.

At Rossall there is a workshop which is popular and well attended. There is only bench accommodation for six at a time; but boys, some of high intellectual power and great refinement, will spend two hours a day, play-time, in carpentry. The boys are taught by the resident clerk of the works. The study of practical engineering, under the chief engineer, is also a matter of considerable interest to boys.

The evidence both from Clifton and Rossall is to the effect that any school will find a workshop to involve very little expenditure, as the superintendent will be able at such times as he is not occupied with the boys to effect a considerable saving, by attending to repairs, the making of desks, forms, &c.

At Eton there is a workshop connected with the laboratory, containing two lathes, work-bench, forge, and a fair supply of tools. It is chiefly used for preparing apparatus for lectures, but boys are encouraged to come there, and taught to make things for themselves. There are, besides this, two or three turners' shops in the town, to which many boys go.

At Harrow large workshops will be erected during the course of 1873.

§ 16.—KNOWLEDGE NECESSARY BEFORE SCIENCE IS TAUGHT.

At Eton boys are expected to have a sufficient knowledge of classics and mathematics to get into the Lower Fifth Form. This may be done by average boys of 13 or 14 years of age.

The examination for admission to the 5th Form includes translation from such books as Homer, Virgil, Xenophon, Cæsar, Latin (prose and verse) composition, ancient history, French. In mathematics—Arithmetic, all, except the higher rules, *e.g.*, discount, profit and loss, stocks. Algebra, to simultaneous equations (inclusive). Euclid, first 12 propositions.

At Harrow no boy is at present allowed to join the Modern Side unless he has been one year in school, and is at least in the Lower Shell.

At Rugby it is considered that a boy "cannot begin physics unless he is fairly high in mathematics;" and that "a certain amount of arithmetical knowledge is absolutely required before a boy can enter the Middle School." At Winchester it is considered that boys should be fairly advanced in classics and mathematics. In the Military and Civil Department at Cheltenham College, a certain amount of knowledge of mathematics is deemed essential; and in the Mathematical School at Wellington College, boys are required to have learnt from two to three books of Euclid, and algebra to simple equations. At St. Peter's College, Westminster, the juniors are required to know the first book of Euclid and arithmetic to decimals; and boys in the upper division, two books of Euclid, algebra to quadratic equations, and a fair knowledge of arithmetic. At Charterhouse, a knowledge of arithmetic, including vulgar and decimal fractions, and of algebra, including simple equations, and of elementary geometry, is necessary. At Christ's Hospital it is generally expected that a boy will only have learnt arithmetic before he enters the natural philosophy class; that he will have learnt a book or two of Euclid and some algebra before he reaches the chemistry class; and that he will have read six books of Euclid, algebra as far as quadratic equations, and some elementary trigonometry, before he begins mechanics. At Dulwich College, instruction in science is open to all boys in the Senior Section and in the Sixth Form. Boys entering the Senior Section are presumed to have a fair elementary knowledge of English, French, Latin, and arithmetic. At Taunton College School a knowledge of arithmetic to decimal fractions, and of algebra to simple equations is required. At University College School boys are expected to have learnt decimals. At King's College School boys entering the Chemistry Class must have mastered the first two books of Euclid, and algebra as far as simple equations; while those who enter the Higher Physical Class must have done the first three books of Euclid, and algebra as far as quadratics. And at the Manchester Grammar School boys who show an aptitude for mathematics are specially urged to enter the Science Forms; but none would be permitted to enter them (except under special circumstances) who have not reached the Fourth Form. On the other hand, at Clifton College, Marlborough College, and the City of London School, the amount of knowledge required is that which will enable boys to take their position in the main divisions of the school; and at Rossall School no definite rule has been laid down at present.

---

§ 17.—REWARDS OR ENCOURAGEMENTS TO SUCCESSFUL STUDENTS OF SCIENCE.

Exhibitions and Scholarships.

At Clifton College a full share of all the scholarships is awarded for proficiency in Natural Science.

At Wellington College there is an annual exhibition of 20*l.* a year for two years, tenable at school, at Woolwich, or at an university, towards which proficiency in science counts.

Henceforward, at Charterhouse School, an exhibition is to be given annually for proficiency in Natural Science. It will be of the value of 80*l.* for four years, and may be held at an university, or anywhere else, provided that the holder satisfies the Governing Body of the School that he is engaged in preparation for some career in life which meets their approval.

At Christ's Hospital a considerable share of the exhibitions to the universities has always been assigned to good mathematicians, and hitherto no *special* reward has been given to Natural Science. The head master of the school states, however, that he is at present trying the following experiment, which may be a precedent: a Grecian, who showed a marked inclination for Natural Science, has been excused the greater part of his classical and mathematical work, and is attending lectures at St. Bartholomew's Hospital, South Kensington, and the Royal College of Surgeons, on physiology, chemistry, &c. If he should satisfy the masters that his aptitude and progress are commensurate with those of his contemporaries who are studying classics and mathematics, the head master will recommend him to the Governors for an exhibition at Oxford or Cambridge.

At the City of London School there is one exhibition of the value of 14*l.* 10*s.*, tenable for one year; and science counts in the regular Scholarships of the school.

At the Manchester Grammar School two Science Exhibitions have been lately founded by Miss Brackenbury, of the value of about 45*l.* a year each, and tenable for three years at the University of Oxford; hence, there is a Science Exhibition awarded two years out of three.

Prizes.

At Eton a prize of 10*l.* and another of 5*l.* are given upon the results of the annual examination, which is held during the summer half, and conducted by independent examiners.

At Harrow two prizes are given annually by the Head Master.

At Rugby School numerous prizes are offered for success in the following branches of Science:—

Physics - -	One prize of	3	guineas.
" - -	"	2	"
Chemistry - -	"	3	"
Geology - -	"	2	"
Astronomy - -	"	3	"
Botany - -	"	2	"
Practical Chemistry	"	3	"

Prizes are also given for the best collections of wild flowers, butterflies and moths, and fossils, made during the summer vacation.

At Clifton College a full share of all the prizes given is awarded to proficiency in Natural Science.

At Marlborough College, though there are, as yet, no Natural Science Scholarships, prizes are freely given to reward success or effort in the acquisition of scientific knowledge.

At Winchester College prizes are given by Lord Saye and Sele for each of the classes in Natural Science.

At St. Peter's College, Westminster, marks gained for Natural Science are added to Mathematical examination marks, and prizes are given separately for Natural Science, in books, if deserved.

At Cheltenham College prizes are given after the Christmas examination in both departments; there have also been special prizes for herbaria of boys' own collection, and for excellence in physical geography; and the "Old Cheltonian Society" gives a special prize for proficiency in physical science.

At Wellington College there is the Governors' prize annually for an examination in a portion of a text-book (prepared without assistance), and for practical work. [Last subject: Last five chapters of Tyndall's Heat, and to find in solution six specified metals.] Prizes are also given twice a year, for term work and examination in science, to the head boys in this subject in the classical and mathematical schools. Two Governors' prizes for botany, viz., (1) for collecting 40 plants *only* of at least 10 different orders, to be carefully dried, with descriptive schedule of each; (2) for preparing fixed portion of text-book and describing on schedule plants presented to them.

At Rossall School prizes are given.

At Christ's Hospital the chemistry and natural philosophy classes get their share of the ordinary prizes.

At the City of London School, one silver medal and 24 prizes (the total value being 10*l.*) are given.

At Taunton College School the head master takes care that at least one of the school prizes is given annually for proficiency in some branch of science, but there is no special encouragement beyond this.

At University College School, book prizes are given in each of the Science Classes.

At King's College School the following prizes are given:—

A. *Terminal prizes.*
- (*a.*) One to the best boy in each of the upper classes, rank being determined by the term's work and examinations.
- (*b.*) Three to the best boys in the large elementary class, one being selected from each of the three divisions, A, B, and C.

B. *Annual prizes.*
- One for Natural Philosophy.
- One for Chemistry.

At the Manchester Grammar School the Science Forms take their full share of the general prizes of the school.

§ 18.—EVIDENCE AFFORDED AS TO THE EFFECT OF SCIENCE TEACHING UPON THE INTELLECTUAL LIFE OF THE SCHOOL.

Mr. Madan, the Science Master at Eton, says:—

"Science work has, no doubt, brought out some (but not many) boys who have previously shown no interest in, or power over, their school studies. Generally speaking, however, the best boys in Classics are the best also in Natural Science."

The Rev. Edward Hale, an Assistant Master at Eton, considers that:—

"The time since which Science has been taught is too short to admit of any professional success, but of three candidates in 1872 for the medals of the Royal Geographical Society, two of the four medals were gained by them, and the other boy received honourable mention.

"Intellectual activity is promoted, and habits of thought and observation are gained. Proofs of this are, that boys not remarkable for proficiency or the interest they take in their usual studies, are sometimes full of interest in learning science, and in rarer instances enthusiastic."

And the Rev. Thomas Dalton, also an Assistant Master at Eton, writes thus:—

"The subject has hardly been introduced long enough to produce success at the Universities. I think it has had a beneficial result upon the school, both generally, and in the case of individuals. Almost all boys have had a certain amount of interest excited in them for this branch of knowledge; in several cases boys who have shown no aptitude for Classics or Mathematics have done extremely well in, and really worked at, Physical Science; but, as a rule, boys who are good in Classics or Mathematics, are good also in Science."

Mr. Wilson, who had had long experience in teaching science at Rugby, in 1866 thus stated his opinion as to the general results of the introduction of scientific teaching, as an addition to the paper read by the Rev. F. W. Farrar before the British Association and quoted by the Rev. T. N. Hutchinson in "Science Work at Rugby," p. 18:—

"The opinion of the body of masters in brief is this. . . . The school as a whole is the better for it and . . the scholarship is not worse. The number of boys whose industry and attention is not caught by any school study is markedly less; there is more respect for work and for abilities in the different fields now open to a boy; and though pursued often with great vigour and sometimes with great success by boys distinguished in classics, it is not found to interfere with their proficiency in classics, nor are there any symptoms of overwork in the school. This is the testimony of classical masters by no means specially favourable to science, who are in a position which enables them to judge. To many who would have left Rugby with but little knowledge, and little love of knowledge, to show as the result of two or three years' work in our Middle School, the introduction of science into our course has been the greatest possible gain; and others who have left from the upper part of the school, without hope of distinguishing themselves in classics or mathematics, have adopted science as their study at the Universities. It is believed that no master in Rugby school would wish to give up natural science and recur to the old curriculum."

The Commissioners will observe that important evidence in the same direction is given in the replies received from Clifton, Wellington, and Manchester.

The Rev. J. Percival writes:—

"I consider that the introduction of science has not in any way interfered with the successful pursuit of the old studies, whilst many of our boys who have gained distinction in classics or mathematics have thus acquired a sound elementary knowledge of two or three branches of science, and many others have had all their powers stimulated by thus finding out that slowness in learning languages does not necessarily mean general stupidity. Thus, the number of boys who do nothing well, and have no intellectual interests, has been materially diminished, and the general tone of the school life has been raised in proportion."

The Head Master of Winchester College says:—

"I think there has been an interest created in botany and geology, which has altered the feeling of contempt for such things which used to be general. I do not think it affects the other studies of the school either way. The principal result is a more general spread of sensible estimates of the value of such knowledge. I do not expect to find individuals do more than *e.g.*, Messrs. F. Buckland and P. Sclater, who were at the school when no regular teaching was given in science."

The Head Master of Wellington College remarks:

"The good effect on the school is undeniable, but for individual distinctive science teaching we must look onward for some little time.

"I introduced it into the classical sixth solely with the view of increasing the boys' interest in life (there is not enough to produce results in external examinations), and of improving their literary work by widening their interests. I think it succeeds in both respects."

It is also stated by the High Master of the Manchester Grammar School that:—

"Since the introduction of the science teaching and the connected changes in our system, the number of our boys has largely increased. By the side of the old classical forms, which remain at least as strong as before, there have grown up science and mathematical forms, training, for a life of study and an University career, boys who earlier would with difficulty have found a place for their special aptitudes. The number of prizes and certificates from South Kensington shows that an influence for good has been at work upon the younger boys, and to name the result which (to the schoolmaster) is, perhaps, the most important of all, the number of utterly listless boys between 15 and 18, who seem incapable of being roused to take an interest in anything, has almost disappeared."

Although the Rev. F. W. Farrar cannot trace any influence which science teaching has exercised on the general studies or on the intellectual life of the boys at Marlborough College, he goes on to state:

"There are, however, two good results which it is producing now, and will produce more and more. 1. It enlarges the range of knowledge and intelligent interests for a large number of boys. 2. It has succeeded in stimulating and evoking the powers of a few boys who had failed completely in other studies. These results alone are amply sufficient to justify its introduction, and encourage us to persevere."

§ 19.—SUGGESTED IMPROVEMENTS IN THE TEACHING OF SCIENCE IN SCHOOLS.

Mr. Madan, the Science Master at Eton, says, with regard to science work at Eton, "It would seem better to " re-arrange the divisions for science work more com- " pletely than is now done. At present the boys (below " the first hundred) are arranged mainly according to their " classical or mathematical work; and there is some diffi- " culty in organizing a consecutive course of instruction for " the boys. A large room for a museum is also much " wanted. There is a good nucleus for a geological col- " lection, but no means of displaying it properly."

And the Rev. Edward Hale, one of the Assistant Masters at Eton, makes the following suggestions:—" By a systematic division of subjects, allotting a certain course for certain school periods, and by making this course progressive, I think, for efficient Science teaching, *every* boy should be taught Erd-kunde, in some such course as the following:—

(i.) The Earth's position in the Solar system.
(ii.) The Atmosphere, Solar Heat (Rain, Snow, &c.).
(iii.) Very elementary Geology.
(iv.) Changes in the physical features of the Earth's Surface caused by Rain, Rivers, Ice, Snow, &c.
(v.) The Sea, Tides, Winds, Climate.
(vi.) Various divisions of animals and plants on the earth's surface, and their distribution.

" After each boy has gone through a course of this, he should choose one of three divisions.

Div. (*a*) Astronomy, Mechanics, Hydrostatics, &c.; and a boy choosing this division should give extra time to mathematics.
Div. (*β*) Chemistry, Heat, Electricity, &c.
Div. (*γ*) Geology, Zoology, Botany, &c."

The Science Master at Harrow states:

" At present all the teaching of Natural Science is carried on in a room which is used during certain hours of the day by one of the classical masters. As soon as the new rooms are finished, it is hoped that the teaching will be much more effective. No practical work, worthy of the name, is now attempted, except with a few boys, and without practical work no real progress seems to be possible, except in the case of boys of unusual ability."

Mr. Wilson, the Mathematical Master of Rugby School, makes the following statement:—

" We want, in the first place, *more Natural Science Masters*. Then we should be able to classify boys better, according to their knowledge and capacity for progress. The difference between the top and bottom of our classes is too great. Then, too, we might teach practical work in physiology and physics, which, under existing arrangements, is impossible. Moreover, we should be able to give special attention to advanced students, who are now left rather too much to themselves, or, at any rate, might be so, as our *system* makes no provision for teaching them. It sometimes occurs to me that this want might be met by the appointment of *visiting masters* for specialities in science (*e.g.*, dissection, microscopic work, &c.), men who would come, as a drawing master does, for so many hours a week.

" In the second place, we want *our Lower School increased* and our Middle School diminished: this would improve our classification; for, at the bottom of the Middle School are large numbers of boys too far below the standard of the Upper Middles to be easily brought into the same system with them.

" In the third place, it would be an advantage *to have our Upper School examined in Science* at the Midsummer Examination by the University Examiner who takes the science in the 6th Form. Lower down than the Upper School, outside Examiners would do us harm, as they would inevitably make masters and boys aim too much at immediate results; in fact, make them cram. But in the Upper School an occasional external Examiner would be of use."

As to the improvements which might be effected in science teaching in schools, the Head Master of Clifton College says:

" I hope to improve it by getting the masters to enforce their methods, by developing more fully the system of classification according to ability and proficiency, by giving more time to the study of particular periods of a boy's school life, thus producing the acceleration of progress which comes of concentration. Thus, and in many other ways, I hope to make the teaching considerably more effective than it has been hitherto, though I am well satisfied with our results, considering all the obstacles that beset any branch of new learning."

The Head Master of Marlborough College states:

" We are anxious to build a laboratory as soon as our means allow us to do so, and we wish to have our own workshops. Further than this, nothing can be at present effected consistently with the character and avowed aims of the school. My experience here has been that the demand for scientific teaching is entirely, or almost entirely, limited by the actual practical requirements of the boys. It seems to be impossible at an ordinary public school to furnish any but a very small number of boys with anything that could be fairly called a thorough education in science. In all the various competitive examinations for which the majority of them are being trained, the part occupied by science is very subordinate to that claimed by literature. Now and then we find a boy with marked scientific aptitude, and it would be our object to stimulate and help him to the utmost of our power; but the practical need of most boys, as well as the express wishes of their parents, render it impossible for us at present to extend the science teaching without injuring the school."

The Head Master of Winchester College says:

" We are at present in such an elementary condition in regard to science teaching that the improvements possible in it, if it is settled that this is a school where it should be made a main branch of study, are endless. They would, *e.g.* involve the entire construction of a system of practical teaching and work. For the purpose of communicating the outlines of general knowledge of some branches of Natural Science in a popular way, and of starting interest and acquaintance with scientific ideas, our courses answer their purpose."

The Head Master of Cheltenham College considers ampler apparatus in some respects necessary. He adds:

" No other improvement seems possible, except by giving more time: but that could only be given at the cost of other subjects. More showy results might of course be produced by selecting three or four boys, turning them away from other work, and concentrating all their other time on science. The selected boys would generally get a scholarship, but their education would be one-sided, and the school organization would suffer."

The Head Master of Wellington College thus writes:

" What we immediately want is (1) a larger laboratory, with (2) more hours of attendance from the teacher of chemistry, and (3) a laboratory assistant. A minor necessity is, that in the mathematical school we want one more grade and one more class room. Each master teaching science loses time unless he has a separate class room, but he can perfectly well use such class room for different subjects."

The Head Master of Rossall School thinks it important to direct the study more in the direction of observation:

" Boys " he says " must be taught to know by sight and weight the difference between the 'Arley' and the 'Wigan Four-foot,' between 'Memel' and 'Dantzig," 'Old' and 'New Red,' 'Arsenic and Salt.' All the theories of combination, number of elementary subjects, doctrines of molecules and atoms of gases, may be reserved till the *savants* themselves are agreed about them."

The Head Master of Christ's Hospital states:

" I intend proposing to the Governors that we should have, each spring, a course of lectures on Botany (illustrated by specimens given to each boy in the class). I should further wish that the junior classes should have at least one hour a week of oral instruction in some elementary physical subject, treated so as to stimulate their powers of observation and analysis."

The Head Master of the City of London School suggests the following alterations:—

(1.) " Chemical proficiency to count in class promotion.
(2.) An hour's oral teaching with demonstration, followed by an hour's book work, and supplemented by practical work. This would of course necessitate—
(3.) More time to be devoted to the study of Natural Science; and
(4.) More assistants.
(5.) More valuable exhibitions and prizes to be given for proficiency in Natural Science."

The Head Master of Taunton College School states the following:—

" *First*, and by far the most important, the establishment of a science master. The subject suffers by being put into commission, however good may be the teachers who share it. It has been taken hitherto by the mathematical master and myself; and we have learnt from our experience that of all possible topics of education, science most urgently requires a single representative professor, whatever aid he may receive from others.

" *Secondly.* Specially constructed rooms and much enlarged apparatus. Our laboratory is of the roughest; our museum cases, which are rapidly increasing, have no special home; we have outgrown our botanical garden, and we have no workshops.

" The Governing Body of the School is keenly alive to our wants and eager to supply them; but the immense expense of new buildings has left them for the present without means; and though they will probably feel justified in shortly granting us a science master, I see no immediate prospect of the other improvements I have stated."

The Head Master of King's College School believes that improvements could be effected in the following manner:—

1. " By the appointment of separate science masters for the School, independently of the College.
2. By the establishment of an independent laboratory, so that all who attend lectures and do the book work might also do practical work.
3. By the appointment of independent examiners to test the work.
4. By requiring of the lecturer in chemistry that he should also take the classes in their book work."

Experience at University College School shows that:—

" A smaller quantity should be taught, but more perfectly. It should be more general in character, and should take in more of the every-day life of a boy, so as to make him think of science despite himself. It should be throughout entirely experimental, to the total exclusion of theories except the few very simple ones, which a boy can easily grasp, and these only sparingly and at long intervals. Far more stress should be laid on the practical work. Boys should be taught some scientific facts much earlier than they are at present, certainly before 13 years of age. As the matter stands now, boys are allowed to acquire unscientific habits of thought before they begin to learn science, and when they do begin, the master has not to teach them science, but to eradicate the evil effects of past neglect—to undo, not to do."

The High Master of the Manchester Grammar School, says:—

" I believe an observatory, a physical laboratory, and a boy's workshop would be of great service, but what we most need is an increase in the teaching staff."

§ 20.—ON THE EXPENSES NECESSARILY ATTENDANT UPON SCIENCE TEACHING.

There is a very widely prevalent idea that science teaching, independently of the teacher, is very expensive, and there is very little doubt that this idea has sufficed to keep science out of a good many schools in which it otherwise would have been at the present moment in full work.

The idea has arisen, it may be imagined, from the considerations, first, that, in science, unlike other subjects, the mere book was useless; secondly, that special buildings and expensive apparatus were, therefore, of the first necessity; and, thirdly, that, this being so, a special teacher, who, as a specialist, would require a higher rate of remuneration than the teacher of the more commonly taught subjects, was also essential.

Let us first consider the question of buildings and apparatus. While it is perfectly true that a great sum of money may be sunk in stones, bricks, and mortar, in building a magnificent laboratory or observatory, and also true that, if the money is forthcoming, there is no reason why science should not be as well cared for architecturally as the other departments of a first-class school, it is equally true that science teaching of a high order may go on quite independently of such outlay or adornment.

The cost of the laboratory buildings at Eton, inclusive of apparatus and fittings, was about 4,000*l*. The sum expended on the shell of the buildings at Harrow (consisting of chemical lecture room and laboratory, physical lecture room and laboratory, balance room, rooms for physiological and other specimens, workshop, and store rooms) was about 4,800*l*. The buildings specially devoted to science at Rugby (comprising a laboratory, two large lecture theatres, apparatus room, a private laboratory, a museum, and an observatory), exclusive of apparatus, cost about 2,000*l*. On the buildings at Taunton College School (which include a laboratory, a museum, and scientific class room), a sum of more than 1,000*l*. was expended. The cost of the chemical lecture room and laboratory, with an instrument room and store room attached, at Clifton College, exclusive of chemical apparatus and material, was 600*l*; that of the physical lecture room and laboratory, with a small class room and store room, exclusive of apparatus and material, was 200*l*. At Manchester Grammar School there are two chemical laboratories and lecture rooms, with balance room and sulphuretted hydrogen room, which, with the fittings, cost 990*l*., and the apparatus 289*l*. 8*s*. 6*d*. The cost of the materials to start the laboratory (a room not specially erected for the purpose) at Wellington College, was about 50*l*.; but a smaller sum, it is said, would have sufficed.

The average annual cost of lectures at Clifton College has been about 15*l*.

At University College School these expenses are met by a fee from each boy attending lectures on Theoretical Chemistry with experiments, varying from 3*s*. to 5*s*. for each term of three months.

At Rugby School the expenses of the laboratory are met partly by an annual allowance of 100*l*., and partly by the payment of 15*s*. a term by each boy in the laboratory, for his share of chemicals and the use of apparatus.

At Taunton College School the cost of solutions and apparatus is under 5*s*. per annum to each pupil.

At Clifton College the cost is about 30*s*. a year for each student in the chemical laboratory; and the average annual cost of the physical laboratory is 30*l*.

At Dulwich College there is no fixed sum for the purpose; in 1871 a sum of 75*l*. was expended on the purchase of apparatus, and about 30*l*. in 1872.

At Manchester the annual cost of the laboratory is about 100*l*.

At University College School, for Practical Chemistry (which is taught in a class averaging 25) the fee for each boy is about 16*s*. a term of three months; but this does not include gas and water, and each boy has to pay for any apparatus which he breaks, unless the breakage is a necessary part of the experiment.

At Marlborough College the annual expense of maintaining the lecture room, museum, and botanic garden does not exceed 30*l*. or 40*l*.

On this point the Rev. W. Tuckwell, in a paper[*] read before the British Association in 1871, says, " It ought to be more widely known for how very small a sum sufficient apparatus can be obtained to teach natural history and experimental science. A laboratory can be fitted up for 20 boys at a cost of little more than 20*l*., while each boy's private stock of glass and test solutions need not cost him more than 8*s*. per annum. Botanical flower-trays, containing 18 bottles, may be bought for half-a-crown; electrometers, telescopes, polariscopes, models of pumps, and pulleys, can be made, after a little instruction, by the boys themselves, who will learn in their construction far more of the principles which they involve than could ever be instilled into their minds by the choicest produce of the shops."

From what I have seen in various schools, I am able to state that this represents the actual facts of the case. At Manchester Grammar School, to take one instance, I saw several polariscopes constructed at home by day-boys of 13 years of age, some of them actually having a metallic framework. One boy had melted up an old teapot for materials.

From Clifton the evidence is to the same effect.

Thus, for continuous courses of Elementary Chemistry and Physics, in which the text books used are Roscoe's Primer and Stewart's Primer, the lecturer adding a good deal to what is contained in these books as he goes along, a lecture table has been fitted up with cupboard, the gas and water laid on, &c., in an ordinary class room, large enough to seat from 50 to 60 boys, at an expense of from about 8*l*. to 10*l*.

The master at the outset expended for chemicals and apparatus, such as a pneumatic trough, large retort stand, gas jars, flasks, &c., the sum of 7*l*. 5*s*.

Some things which he only requires occasionally, such as air pumps, models of pumps, &c., he has hitherto borrowed from the Physical room.

But it is stated, that with a grant of from 3*l*. to 5*l*. a year, he can keep up and add to his stock of material and apparatus, so as to be able, in the course of about two years, to do all he requires without borrowing anything.

The report then states: " Our experience in connexion

---

[*] The Obstacles to Science Teaching in Schools. [See p. 66.]

" with his room shows that elementary instruction in " science can be carried on at a much cheaper rate than is " generally supposed, provided that the teacher will take " the trouble to think for himself, and expend a little time " in preparing apparatus fromsimple materials."

In these small laboratories it is found that the complete table outfit usual in larger laboratories is quite unnecessary; two or three sets of reagents (mostly prepared by the boys themselves in quantity so soon as the use of each particular one of each reagent is taught) are found to be amply sufficient. This arrangement, of course, largely reduces the initial expenses.

The large use made of the Science Primers in Chemistry and Physics by Professors Roscoe and Balfour Stewart justifies the reference in this place to the sets of apparatus supplied with these primers to illustrate all the experiments given by the authors.

The following is a list of the apparatus with which it is expected that each student of the Government Science School will be furnished:—

	s.	*d.*
Conical brass blowpipe with bone mouthpiece -	2	0
6 inches platinum wire - - - -	0	6
Platinum foil, 2 inches long, and 1 inch wide -	1	0
Test tube stand, 24 holes - - - -	2	0
18 test tubes, 6 in. by ¾ in. - - -	1	9
12 test tubes, 5 in. by ½ in. - - -	0	10
2 boiling tubes, 8 in. by 1¼ in. - - -	0	5
2 test tube brushes - - - -	0	5
Set of 3 beakers - - - - -	1	0
German flasks, 1 of each, 2 oz., 4 oz., 8 oz., 16 oz., and 30 oz. - - - - -	1	9
Berlin porcelain crucible 1½ inch diameter -	0	4
Berlin porcelain evaporating basins, one of each, 2¾ in. and 3½ in. diameter - - -	0	11
Funnels, one of each, 1½ in., 2 in., and 3 in. -	0	6½
English filter paper, cut, two packets of 100 filters each 2¾ in. and 4½ in. in diameter - -	0	9½
Iron retort stand with two rings, clamp, and square iron block - - - - -	7	0
Iron wire gauze, 5 inches square, 2 pieces - -	0	4
Tin plate sand bath, 5 inches diameter - -	0	4
6 watch glasses, 2 inches diameter - - -	0	6
½ lb. soft glass tubes $\frac{3}{16}$ in. to ¼ diameter - -	0	8
½ lb. combustion tube, ⅜ in. bore - - -	0	8
¼ lb. glass rod $\frac{3}{16}$ in. diameter - - -	0	4
2 feet black caoutchouc tube ⅜ in. bore - -	1	4
2 feet black caoutchouc tube ⅛ in. bore - -	0	8
Thistle funnel, 18 inches long - - -	0	4
3 dozen assorted corks - - - -	1	4
Woulf's bottle, 2 necks, pint size - - -	1	3
Stoppered German glass retort, 2 oz. - -	0	7
Set of three cork borers, $\frac{3}{16}$, ¼, and ⅜ in. with iron rod	1	0
Triangular file and handle - - -	0	8
5 in. round file and handle - - -	0	9
Bunsen's gas burner, with blowpipe jet, star support, chimney, and rose burner - - -	3	6
Iron crucible tongs - - - -	1	0
4 inch porcelain mortar - - - -	1	0
Box of test papers, blue and red litmus - -	0	6
Solution of Cobaltous nitrate ½ oz., stoppered bottle	0	7
" argentic " ½ oz. "	0	6
" platinic chloride ½ oz. - -	1	9
1 pint methylated alcohol in bottle - -	1	6
Glass spirit lamp, 4 oz. capacity - - -	0	9
Deal box to contain the set of apparatus - -	2	0
£2	5	1

It is stated in the *Science Directory* that the set complete can be obtained in a box for 2*l.* from Messrs. J. J. Griffin and Son, Garrick Street, London, W.C.; Messrs. Townson and Mercers (late Messrs. Jackson and Townson), 89, Bishopsgate Street Within, London, E.C.; Mr. M. Jackson, 65, Barbican, London, E.C.; Messrs. Zimmermann, 6, Fen Court, London, E.C.; Messrs. Harvey, Reynolds, & Co., Leeds; or Messrs. Mottershead & Co., Market Place, and St. Mary's Gate, Manchester; but schools are not required to purchase the apparatus of these manufacturers.

§ 21.—SCIENCE TEACHERS.

There is great divergence of opinion as to whether it is difficult or not to obtain qualified teachers of science. There is much evidence, however, to show that there is a real difficulty in obtaining "down-right good men," except in the case of the richest schools. In fact, in the case of many schools, the area of choice is limited, as there is a widespread feeling among the Head Masters of the old foundation schools that it is important that the Science Masters, like the Form Masters, should be University men. Nor is this all: the Head Master of Rugby states:—

" I do not think I could improve upon the teachers who might be selected from Oxford and Cambridge. They have been specially trained as students. As teachers their proficiency has been attained by practice. As students, the University curricula with professorial guidance, and the competition for the various distinctions open to them, have given them the necessary training. I would here observe that a mere chemist, geologist, or naturalist, however eminent in his own special department, would hardly be able to take his place among a body of masters composed of University men, without some injurious effect upon the position which science ought to occupy in the school. I would add that it seems to me highly important that a school teacher of these subjects should be thoroughly practical in his knowledge, skilful in experimenting, and ready in devising simple and inexpensive lecture illustrations. In preferring the two older Universities, I do so only by reason of their stronger general sympathies with public school teaching. I am aware that, if I merely wanted a highly scientific man in any branch, I might find him equally at Dublin, London, or a Scotch University."

The Head Master of Clifton refers to the "want of previous training or experience on the part of the masters, " each one having to a great extent to discover his method " by experiment"; and he further states that he is of opinion that Oxford turns out the best teachers for such a school as his than any other single place. He adds:—

" But they cannot be said to be in any way trained for their work, having in fact to learn their business when they come to us; and the Oxford system has at best this very grave defect, that the men who are trained in it are apt to take away with them very extravagant notions about the apparatus necessary for teaching science in schools. They might with advantage be made a great deal more capable of helping themselves."

This want of training of the masters in the art of teaching and in practical work is often referred to, and forms the subject of many suggestions.

The Master of Cheltenham states, as a condition of things strongly opposed to Graduates of either Oxford or Cambridge undertaking the duties of Science Master at a school, that:—

" The Universities offer now-a-days so attractive a home for men of science, whether married or unmarried, combining the advantages of ample leisure, fair emolument, splendid collections from museums and libraries for study and observation, that even large public schools, in pleasant positions, find it hard to attract first-rate teachers of science, except the man himself has a genuine love for boys."

The Head Master of Winchester alludes to "the difficulty of finding teachers possessing actual knowledge of " practical and experimental kinds, who are also able to " manage a class of boys."

The Head Master of Christ's Hospital states that "the " teachers of the existing staff are mostly unacquainted " with Natural Science, at any rate in such a measure as " to be adequate teachers of it."

§ 22.—ON THE OBSTACLES TO SCIENCE TEACHING IN SCHOOLS.

In those Schools which I visited, I was very careful to inquire into the opinions of the Masters with regard to the various obstacles which exist to the introduction of Science into schools. Some of these obstacles are very real; some, I believe, are more or less imaginary. In the answers to question 32 will be found very important evidence concerning these obstacles; and I may say that so far as the real obstacles go, the opinion which I have formed from my visits to the various schools, induces me to place this statement in the strongest possible form.

First of all, I think, really comes the very grave obstacle, that if Science is intended to be introduced into a school at the present day, a crowded curriculum is to be met. The curriculum in most schools is already so large that it is taken for granted that it cannot be extended. It therefore becomes a question of eliminating something before Science can be properly introduced. The next question is, what should be eliminated? And this question is one extremely difficult to be answered, or at all events it is answered with difficulty; although if a school were merely considered as a place of training, and not a place where useful knowledge is imparted, the difficulty would really be seen to be a lighter one than it is supposed to be.

It is stated at Marlborough that the boys' time is already absorbed by studies which have of late years been largely multiplied, and which in most cases they know to be essential to their future prospects in life, seeing that most of them will have to be examined in all those subjects. It is not merely a question of the time taken up by the other subjects; the boys are absolutely distracted by them, and cannot approach a new subject, and especially such a new subject as Science, with that undivided attention which is absolutely necessary, if any advance is to be made in it.

The Head Master of the Manchester Grammar School states, "The boys in the classical Forms are fully tasked, I " think overtasked, by their present work, so that under " existing conditions they cannot be taught Science with " any good results; many boys, however, are detained by " their parents in the classical Forms, who mentally would " profit far more in a Science Form; but this generally is " done for the sufficient reason that a literary training is " of vital importance to the boy's prospects in life."

I do not find that this difficulty of introducing Science has been at all regarded in connexion with the fact of the new kind of training altogether which comes from dealing with the sciences of experiment and observation, and I believe that it is extremely important that this point of view should be developed in order to introduce Science into Schools where at present it is not taught, and to extend the teaching of Science in those schools where it has already obtained a footing.

But the want of time, after all, is only one of the difficulties. In the old schools the tone of the school is distinctly against Science, not so much on the part of the Masters as on the part of the parents, and, to a great extent, on the part of the boys themselves; and I believe it is from this point of view (and I express my opinion with much diffidence) that the introduction of Science into the modern sides merely of schools, whether of this class or of any other class, will eventually be a matter extremely unfavourable to Science. Not only will Science be looked upon as on sufferance, but its training power will be entirely disregarded.

Mr. Madan's idea of the obstacles at Eton is as follows: " The natural unwillingness of parents and tutors to allow " boys to give up much time to a Science which has not " hitherto had much influence on a boy's place in the " school, and which does not often serve as an introduction " to any recognized career or profession—this unwilling- " ness is quite justifiable." Mr. Dalton points out, "The " whole tone of the school has until lately been so ab- " solutely classical, that Science had to start with a certain " amount of prejudice against it. This, I think, it has " certainly overcome, it being now generally allowed that " the subject has done good work for the boys."

There is ample evidence to show that where Science has been best taught its effect upon the boys is most acknowledged. Thus at Eton, as already seen, it is acknowledged that the subject has done good work for the boys. At Wellington it is acknowledged that the past feeling of inferiority to other subjects is perhaps hardly just, and I am sure that the Head Master of Clifton College is quite willing to acknowledge the importance of a Scientific training, although he states that a prejudice against Science, as a new study, to some extent lingers in the minds of both men and boys.

Another real obstacle is connected with the Science Masters. It is stated in evidence that in the great schools the Science Masters, as a rule, are not sufficient in number, and are not sufficiently trained. When Science has been introduced into a school, it has been introduced very much as any other subject would be—any other subject, I mean, of quite an inferior kind, and one, like most of the old studies, in which the book is all sufficient. The Science Master has faced his work, lectured to his classes, prepared his experiments, revised his note-books, prepared his examination papers, and has then either broken down, or has appealed for more help, which he has not been able to obtain. Thus we read in the information placed at my disposal by Mr. Wilson of Rugby, that the greatest obstacle is the want of time on the part of the Masters. He remarks, " They have time to do their regular work, prepare lectures, " look over books, &c., but not time to give to individual " boys the help and encouragement that they need. Boys " are not unwilling to work, but they require absolute direc- " tion what to do. They will often undertake very " laborious work, if it is absolutely defined; but to direct " scientific work takes much time."

I have referred in another section to the evidence concerning the training of the Masters, which goes to show that although the present staff of Science Masters is altogether inadequate, more might be done by the existing staff, if, as a rule, they were more conversant with the methods of teaching and experimentation.

A host of obstacles in the various schools depends upon the organisations of those schools, and I say this, because it is not a general complaint; the complaint only exists in the case of certain organisations. Thus at King's College School the necessity of accommodating the hours of Science lectures to the arrangements of the College is pointed out as one of the obstacles.

At Eton it is acknowledged that an obstacle exists in the fact that the divisions of the school are made with reference to classical work only.

Again the Master of Clifton College acknowledges a difficulty in classifying boys according to proficiency, and arranging the teaching so that the boys may be kept as active as possible, and not remain simply passive listeners to a lecture. He then goes on to add, that another obstacle lies in the fact of the difficulty in the way of a progressive arrangement of classes, at least in a large school, to get over which it is necessary to teach several classes simultaneously. This, of course is met by having more Science Masters. At Clifton three or four sets are thus taught simultaneously.

From King's College School comes the statement of an obstacle which it is perfectly simple to overcome. This obstacle consists in the late age and the backward state in which boys join the school, especially the Modern Department, and we may add to this, the rapidity with which boys pass through that Department. I believe that when the importance of Science teaching comes to be generally acknowledged, such an obstacle as this must cease to exist; and it is noteworthy that the obstacle is in the main urged in connexion with the Modern Department.

Another drawback is one which, it is to be hoped, is also easy of correction. The requirements of the Universities, and especially the University of London, have a most objectionable influence upon the schools. We learn from University College School that "The Universities require " more than can be properly learnt by a boy of 16; they " require that knowledge to be very special in character, " and not by any means to have any connexion with the " daily life of the boy; he is asked about chemical sub- " stances, which he may never see or hear of again for the " rest of his life; they seem to lay more stress on theo- " retical than on experimental knowledge, judging from " their questions and from the candidates who pass; in- " deed, the boys will often leave the practical class for the " purpose of preparing for the examination. Lastly, they " require an inordinate amount of knowledge in other than " scientific subjects, so that a boy cannot well begin Science " before 14 years of age."

Another obstacle which is urged, and which I believe to be more unreal than is generally imagined, is the cost of introducing the new study. No doubt a Laboratory is needed; no doubt a special class room is desirable, but in many schools these requirements have been met without any additional expenditure; but when once the *locale* is found I believe that Science can be introduced at one tenth of the cost which is usually supposed to be that which is absolutely essential.

But to come back to the real obstacles, we find what I have had to refer to in other sections of my report, viz., the utter absence of an assured career for any student of Science. At Eton it is stated that the rewards for success in Classics are so great, that a boy must hesitate about endangering his progress in them, and it is difficult to reward him adequately for success in Science. Another Eton Master also refers to the belief amongst parents and Masters, that Science does not pay.

At Marlborough it is acknowledged that the demand for Science teaching amongst parents is very small. The general opinion seems to be that an ordinary knowledge of Science does not open the way for any career in the future, and that a boy is more likely to win for himself a future position by following the studies which form the main curriculum of teaching.

At Wellington the feeling that Science does not pay as well as other subjects do is also distinctly referred to.

Again let us take the case of Christ's Hospital. Most of the boys leave that school before 16, and at present there are hardly 30 boys in the school over that age. These are all aiming at University Scholarships; and it is stated by the Head Master that to these hitherto Classics and Mathematics have been found the only, or at least, the readiest, avenue.

The Head Master at Rossall not only points to the greater inducements held out by the Universities for the study of Classics and Mathematics, but he refers to the unsettled state of opinion as to what is the real aim of scientific study; and the instinctive feeling of the boys that, as at present taught, Science is not equal to Latin and Greek, or Mathematics, for educational purposes.

§ 23.—HOW THE UNIVERSITIES CAN BEST AID SCIENCE TEACHING.

The Commissioners will gather from the replies to Q. 33, that there is an almost unanimous opinion among those connected with the great Schools, that the Universities can best help the cause of Science by offering more Scholarships and Exhibitions for that subject, so as to diminish the disparity in the rewards held out for the various studies—a disparity so great at present that many Head Masters feel that in recommending the study of Science they are injuring the prospects of boys.

More Fellowships are also suggested, but the opinion is that Scholarships are more important than Fellowships for the immediate purposes of the Schools.

It is also felt that the Science-teaching at the Universities might be more adapted than it is to turning out Masters; special courses of lectures on the art of teaching (similar to those at the Science Schools at South Kensington), and on the construction and use of inexpensive apparatus, being given. The Head Master of Christ's Hospital suggests that "the Universities might supply the deficiency of highly-" trained Scientific Teachers, by endowing a class of local "Sub-Professors who should further the teaching of Natural "Science in the schools of a given district, by lectures, "examinations, and inspection, and by their advice and "suggestions to the teachers of the several schools with "regard to subjects and method of teaching, choice of "apparatus, &c." The Head Master of Rugby points out how Science Teaching in schools would be aided by the Unversities maintaining a high standard of teaching and examining, so that they will be able to send out the best possible teachers and examiners. I have already referred to this question of Teachers in § 21.

Some Head Masters suggest modifications in the University curriculum. The Head Master of Winchester would make it incumbent on the Universities that *their best men* should know some rational amount of Natural Science. The Head Master of Harrow suggests making some branch of experimental physics or chemistry a necessary part of the first examination that is passed by every undergraduate. The Rev. J. Percival proposes the institution of "examina-"tions such as those asked for by the Head Masters' Con-"ference, and the modification of the general curriculum, "so as to offer a fair field for these new studies." The "Head Master of Taunton College School considers that Science Teaching would be aided "most materially by "making a certain amount of Science compulsory in the "matriculation and little-go examinations. Cambridge "might also include Science in the list of subjects on which "the Syndicate offer to examine schools; and Oxford "might rescind the mischievous rule which limits junior "candidates in the local examinations to five optional "subjects."

The High Master of the Manchester Grammar School and the Head Master of the City of London School make substantially the same proposal that the Commissioners have already embodied in their Third Report:—"Much addi-"tional good would be done if the Universities instituted "a general matriculation, or leaving examination, compris-"ing—1, Mathematics; 2, Science; 3, Language and Li-"terature; and allowing excellence in one subject to com-"pensate for defects in another."

The Head Master of Christ's Hospital adds that, "If "the scheme of organised examinations of schools by the "Universities (suggested by the Conference of Head "Masters), should be adopted, Natural Science would find "its place in such examinations."

The Head Master of Winchester also suggests that the Universities should frame "some definite courses of "Natural Science teaching: (*a.*) Of a standard fitted for "a boy's main study; (*b.*) Of a popular kind, fitted to be "an universal study for all boys, subordinate in position, "but sufficient to give some real knowledge."

The enormous influence for good or evil of University examinations upon school teaching may be gathered from the evidence from University College School:—"Every im-"provement the Universities introduce into their examina-"tions must be attended with improvement in our "teaching; *e.g.*, if the examinations of the University of "London became practical in all departments of Science, "as they are, for instance, at University College, in the "case of botany, classes under instruction would be stimu-"lated to much greater interest in, and attention to, the "details of arrangement and manipulation of apparatus; "and the substitution of practical instruction for teaching "by the exhibition of experiments only, must soon follow."

Mr. Wilson, the Mathematical Master of Rugby School, is of opinion that the Universities could best assist "*by* "*teaching Science well themselves*, and sending out good "teachers, men of real culture and education. Boys," he continues, "soon find out the man of one idea: they use "him, and get knowledge from him as they would from "a laboratory assistant. They ought to turn out men who "will show that Science is a branch of culture as well as a "department of knowledge.

"By *gradually*, as the competition increases, *giving more* "*scholarships for Science*, and making their examinations "more uniform.

"Most of all, *by making themselves famous as schools of* "*Science*, and having the most distinguished Professors; "that boys may aspire to be students under Stokes or "Rolleston, as they used to aspire to read Greek with "Jowett, or Latin with Conington."

§ 24.—HOW THE GOVERNMENT CAN AID SCIENCE TEACHING.

It is acknowledged that Science is neither recognized nor paid nor rewarded by the State as it ought to be; that mainly owing to this, there is no career for Science, and that parents and masters are justified in avoiding it.

The Head Master of Rugby states, "A scientific career, "as such, opened to the aspirations of candidates such as "I believe exists in some countries, might probably "influence for good both pupils and teachers by giving a "definite object with tangible results."

Mr. Wilson, the Mathematical Master at the same school, writes, "The main influence of Government is in-"direct; if they honour science, and value it, and make its "study a national object, they do more to encourage "Science in schools than by any direct interference."

I have found the Head Masters of the Schools I have visited fully impressed with the idea that the Government can, if it chooses, bring a great influence for good to bear upon Science Teaching in Schools.

One of the means most frequently pointed out is the introduction of Science into all examinations for the Government Service. The Head Master of Marlborough would make some branch of Science compulsory in all such examinations. The Head Master of Christ's Hospital thinks that the Government should require Natural Science in its competitive examinations. The Head Master of Rossall remarks :—" One way in which Government " might help, would be to offer us commissions or civil ser- " vice or colonial appointments for excellence in Science " studies: anything, in short, to balance the overwhelming " attractions of classical and mathematical proficiency as a " means of getting a livelihood."

With regard to inspection by an officer of the Government, though the opinion on this point is not unanimous, there is a balance of evidence in its favour. From Eton comes the suggestion that the Inspector should be also a lecturer, so that a greater interest for Science might then be developed.

The late Head Master of Wellington College, though in favour of inspection, is of opinion that the inspection should be general :—" It is important that all the " subjects of a school education should be pressed forward " with an even hand, and the relative values affixed to " them should not be destroyed, though from time to time " they may be carefully remodelled. The inspection of any " one single branch of work would destroy undesignedly, " but steadily, the balance of studies. The examining " power (whatever it is, Government or University) should " be comprehensive, and provide for the inspection of all " subjects." Here I would venture to remark that it is not a question of *destroying* but of *creating* a proper balance.

This view is exactly that of the Head Master of " Taunton College School," who states :—" *For some years* " *to come, until Science is thoroughly established*, I think an " annual Government inspection, with grants or prizes of " moderate value or a reward for attendance, would work ex- " ceedingly well. But I hope ultimately to see the day when " all boys at all schools shall undergo a compulsory public " examination in Science, as in every other subject taught, " at least once a year."

The opinion of the High Master of the Manchester Grammer School on this point is thus stated :—" Nothing, " in my judgment, would be so beneficial to endowed " schools as systematic inspection and subordination to " some central authority. Whatever assistance scientific " studies would receive from such a change, and it would " be great, Classics, Mathematics, and Modern Languages " would receive hardly less."

The Head Master of the City of London School is of opinion that Government inspection (if not carried to excess) by one experienced in teaching, would be extremely useful.

I next come to the aid which can be so readily afforded by Government, and by no one else, in the matter of museums, instruments, &c.

The Head Master of Winchester considers that important aid may be rendered " by carrying into other branches what " has been done for botany by the preparation of sets of " plates, *i.e.* by organising a system for supplying sets of " typical specimens of zoology, geology, &c. Nothing," he adds, " but a central organisation can insure schools, which " have no special opportunities, the possibility of obtaining " the necessary collections."

And the Head Master of Marlborough :—" By setting " aside a building at South Kensington, or elsewhere, in " which the finest modern physical apparatus could be " seen, such as the collection of the Conservatoire des Arts " et Métiers in Paris, or the Physical Cabinet in Leyden." " By the grant of moneys for the purchase of apparatus and " diagrams, or the loan of such apparatus, or the autho- " risation of the sale of such apparatus at cost price, and by " accredited agents."

Mr. Madan, of Eton, suggests " grants or loans of apparatus, diagrams, &c., as is done in the case of Art Schools."

The Head Master of Clifton College thinks that " the " Science Department under Government might be of great " service by cheapening still more the supply of books, " diagrams, apparatus, &c."

The Head Master of King's College School desires that aid should be rendered by " donations of scientific books " to form a school library of Science, and scientific speci- " mens and instruments of various kinds."

The Head Master of Christ's Hospital would wish Government aid in the formation of School Museums and Collections.

As to how Government could assist Science teaching in schools, Mr. Wilson, the Mathematical Master of Rugby School, makes the following observations :—" Help might be " given towards *the formation of museums* by free grants of " duplicate specimens; diagrams and photographs might " be published by the Geological Survey that would greatly " facilitate the teaching of Geology. A *Training College for* " *Science Teachers for Second-Grade Schools* is, I believe, " urgently wanted."

Mr. Griffith, the Science Master of Harrow, says :—" If " ' Leaving Examinations ' were established, increased at- " tention would necessarily be given to Natural Science at " schools, if some branch of the subject were made com- " pulsory in these examinations, whether conducted by the " Government or by the Universities.

The Head Master of the City of London School considers that aid might be rendered by awarding prizes; and he suggests " that the pupils of such schools should be allowed to " take the prizes and medals awarded by the Science and Art " Department (South Kensington), but at present limited " to the students of Government Science Classes. Also, " that the list of successful candidates be published."

MEMORANDUM ON THE MODERN DEPARTMENT.

In the chapter dealing with the Organisation of Schools, I have pointed out that the schools may be arranged into four Groups :—Schools with only one main line, and that Classical; Schools with only one main line, but in which general fitness determines the place; Schools with a Modern Side; and, finally, those Schools which, in consequence of some peculiarity, do not conveniently fall within either one or the other of these divisions.

It is not necessary that I should remind the Commissioners that the "Modern Side" is a recent introduction, and that not only have we now many schools with Modern Sides, but even Modern Schools altogether, and a gradually increasing desire that more Modern Schools should be established. Although this desire exists, I have not heard it clearly expressed whether it is the intention of those educationalists who propose the erection of Modern Schools that these Secondary Schools should be feeding grounds for the Universities; but I wish to point out that, if it is intended that they should be feeding grounds for the Universities, then a condition of things will be brought about diametrically opposed to the spirit of the Commissioners' Report on the Universities of Oxford and Cambridge. In that Report it is proposed that in the case of every student who proposes to carry on his education at the University, there should be an Examination, preferably on leaving school, which " might serve to mark the limit between School " studies and University studies, so that the student whose " performance in the Examination had come up to a certain " standard, might be supposed to have acquired such an " amount of general culture and scientific knowledge as to " entitle him, thenceforward, to be left as free as possible " to choose for himself among the great lines of literary or " scientific study." In fact, the Commission has proposed that in the case of all those students whose education may be expected to culminate at the University, the bifurcation between the various lines of study, Classical, Mathematical, and Scientific, should take place at the entrance to the University, and not before. With the introduction, however, of Modern Sides to existing Classical Schools, and with the interpolation of Modern Schools into our general educational system, we have a bifurcation coming at a much earlier date, and under the present disorganised system we may have any number of bifurcations going on at any number of epochs in a boy's life.

Although it is impossible to speak too highly of some of the arrangements of several of the Modern Schools which I have inspected, I am not saying too much when I state that my impression has been, especially with regard to some of the schools that I have visited, that a Modern Side is a modern mistake. In some schools I am informed that, in the case of boys of the Modern Side, there is an absence of that high tone which is one of the crowning glories of our English Schools, this being no doubt to a certain extent brought about by the limit placed upon a boy's ambition. He finds, in too many cases, boys of his own age, friends of his own, on the Classical Side, going up to the highest places in the School, whereas it is absolutely impossible for him to achieve that position by any amount of diligence in his own studies. In fact, my opinion with regard to Modern Sides is exactly the opinion which was arrived at by Mr. Fitch when he inspected the Schools in the West Riding of Yorkshire, and whose Report I have become acquainted with quite recently. He remarks :—

" It will be observed that in both these cases the Modern

Department is regarded as of inferior rank to the Classical, is under-officered, and derives little advantage or strength from its connexion with the Grammar School. It is rather an excrescence than an organic part of the school. It exists rather by sufferance than with strong approval. To try an experiment of this kind with success, it is necessary that some of the teaching power of the Larger School should be avaliable for the Modern Department; or that if it be regarded as a separate school it should be well organised on that footing, and have suitable classification and an adequate staff of teachers for its special work.

"But if the ordinary course of instruction in the Grammar Schools were made at once more comprehensive and more intelligent, the need for a Modern Department as a separate institution would be greatly diminished. A course of instruction might surely be devised which, while equally good for the purpose of those who contemplate an University career, would be more serviceable to that large number whose education terminates earlier. If in the Lower Forms of a School English Grammar were taught *pari passu* with Latin, if more attention were paid to reading, to English composition, and to the cultivation of a boy's general intelligence; if arithmetic were taught in its principles, so that as far as it was worked it was understood; and if more pains were taken with the finish of all written exercises, there would be little need to separate the two classes of pupils. Such a course, even if frustrated at the age of 14 or 15, would have an unity and a value of its own. More oral teaching, more frequent appeals to the intelligence and taste of the pupils, in connexion with elementary work, the earlier introduction of History, and Elementary Science, and the postponement of Latin versification, and of Greek, to a later stage of a learner's course, would meet the requirements of 80 per cent. of the scholars far more effectually than the present course. And it is difficult to believe that the interests of the remaining 20 would be sacrificed to such an arrangement. On the contrary, I believe that some unexpected advantages would accrue, and that the delay in mastering some technical details would be more than compensated by the intelligence and consequent rapidity with which they could be acquired."

Now with regard to the Higher Classical Schools, such as Eton, Harrow, and the like, it is quite possible that Mr. Fitch would consider that the remedy which he here proposes would be sufficient; but it would be met by the objection to which I have alluded in another section, that the number of subjects already taught on the Classical Side is too large, and the detail in which they are studied is so great that modern subjects could not be properly introduced to the extent which, perhaps, would follow from Mr. Fitch's suggestion. But there is evidence to show, from the admirable way in which Science has been introduced and taught at schools like Rugby and Eton, that, so far as Science at all events is concerned, a Modern Side is not absolutely essential. No doubt the *raison d'être* of most of the Modern Sides in Schools is the crushing weight of competitive examinations, which seem every year more and more to destroy education, and to make the earlier years of a boy's life absolutely destitute of training: turning, in fact, places which should be educational into mere repositories of knowledge more or less useful. I would only point out that if the Commissioners' view of the general culture necessary, as a rule, for entering the University be generally accepted, Modern Sides and Modern Schools will be almost unnecessary, and that no bifurcation will be needed if an initial simplification of subjects be accepted. If, for instance, the parent of a boy, when he sends him to one of the Higher Secondary Schools, were to be assured that that boy's career in life would not be injuriously affected by his scientific studies, while, at the same time, he would wish him to undertake those studies, what easier method would there be than, by the postponement of Greek, to allow that boy's studies to commence side by side with the general culture, including the form work of the school from the day of entrance until the day he left that school? Of course this would assume not only this simplification of studies to which I have referred, and for which Mr. Wilson so eloquently pleads, but it would necessitate that a boy's place in the school should depend upon his general fitness. Thus, for instance, we might imagine a school on the scale of Eton, in which the boys would all of them, from the very commencement to the very termination, undergo a general training in Classics, Mathematics, and Science, and that without any strain; whilst in addition to this general training he might at the same time be preparing himself either for University honours, or for a subsequent career in either of the three great branches of culture. That this is perfectly feasible is shown by the fact that at the present moment even in the Sixth Form at Rugby, a boy is allowed to drop certain of the higher Classical subjects, and to replace them by Science, which is equally marked with the Classical subjects, so that he is no loser by the change.

It must be perfectly understood that, so far as I have gone, I am considering the case of boys who propose to terminate their career at the Universities. In the case of those, however, who, from various causes, do not propose to enter the Universities, I believe that at the present moment there is a wide gap in our educational system; and that the suggestion of the Head Master of Marlborough, that there should be a school in which Science alone is taught, would be a suggestion of the very highest value; provided, always, that into this school shall come boys who have undergone a certain amount of general training in some Secondary School. I presume that the Commissioners would on no account endorse the suggestion, if it were intended that such a school should replace the present secondary instruction, instead of being supplementary to it, in the case of certain boys who do not go to the Universities.

There is another point in connexion with the Modern Schools, and it is this: it is not too much to say that it is quite possible that the introduction of Modern Schools, and the introduction of Science into the Modern Sides of Classical Schools, will, in the long run, instead of facilitating, as it is thought, the introduction of Science into the Classical Sides, prevent any Science being taught there; so that after Modern Sides and Modern Schools have been in operation many years, the culture will be more one-sided than ever, and such a Leaving Examination, as the Commissioners have proposed, will become year by year more and more impossible. I believe that at the present moment, in the absence of Modern Schools, the Masters are perfectly prepared to add Science to their curriculum, and to teach it well, if they can be only told how this is to be done; if some general consensus can be arrived at with regard to the subjects to be given up, if some general instructions can be given to the Masters, such as those indicated by the Endowed Schools' Commissioners, and if a supply of properly taught Science Masters can be procured. It is my belief, from what I have seen, that if the Commissioners can only succeed in creating a career for a man of science commensurate with the careers opened to the older studies, and, if, at the same time, Greek is given up as a compulsory subject at the older Universities, as it has already been at the University of London, all the other difficulties which harass the introduction of Science into Schools will gradually disappear. The establishment of a career, both at the University and in the national life, will at once relieve parents from the grave and very proper objections which they have at present against their children forsaking the old lines which have always been so well rewarded. With this will come—seeing that more will be taught Science—more people competent to teach it.

MEMORANDUM ON SCIENCE PROGRAMMES.

I have often heard the opinion expressed that much good would follow if Her Majesty's Commissioners would frame programmes, showing, however roughly, the order in which, in their opinion, the various subjects should be taken up, and the course of study to be adopted in each. I am certain, myself, from what I have seen, that such a course of action would be largely beneficial, not because such programmes would be, or should be, absolutely followed in each case, but because such an authoritative expression of opinion would be of the highest value to teachers who, at the beginning of their careers, have necessarily small acquaintance with the best methods of teaching.

I append, as models of what I conceive such programmes could most usefully be, the Sketches of Instruction in Chemistry and in Physics drawn up by Professor Frankland and Professors Goodeve and Guthrie. [*See* pp. 85–93.]

Appended Statements.

I.—VARIOUS PAPERS BY MESSRS. WILSON, TUCKWELL, FOSTER, AND HALE ON SCIENCE TEACHING.

See Introduction.

1.

On Teaching Geology and Botany as a part of a Liberal Education.* By J. M. Wilson, M.A., F.R.G.S., late Fellow of St. John's College, Cambridge, and Assistant Master at Rugby School. [Extracted from the "Educational Times" for April 1872.]

In accepting the honour of delivering before you a lecture on some branch of education, I was much more influenced by the desire to state, in as distinct a shape as I can, what seems to me the present difficult problem respecting the true position of these sciences in liberal education, and to make suggestions towards its solution, than by the hope that any remarks of mine, on the methods of teaching the special subjects of geology and botany, will be found valuable to teachers. For these subjects are not particularly difficult to teach, but their right position is rather difficult to assign. And this position, and the whole question involved in it, is of more importance at the present moment than the method of teaching. For we are in real danger of drifting into a new system of education, which loses more, when compared with the old, by its shallowness, than it gains in width. And, therefore, it is necessary that all persons who have in any way influence over educational tendencies in England should consider the whole question, and have, if possible, some definite and coherent aims. And, therefore, on the present occasion, simply to press the claims of one subject, without showing its relations to others, would be to mislead you as to my own views, and would be to avoid the most interesting aspect of the question.

Further, I am bound to confess at once that, except principally with this view, I have no right to make any remarks on the teaching of either geology or botany Viewed on their strictly professional and scientific side, I should be totally unfit, from sheer ignorance, to teach either of them. I am not a professed botanist or geologist, and can only dare to offer any suggestions as to teaching these subjects by premising that it is only so far as they seem to me legitimately to enter into a course of liberal education, that I have had experience in teaching them, and in seeing them taught by others. I have very often to deplore my want of knowledge in these very subjects; but as it is certain that they will be taught by many who are not professed naturalists, my experience may be of some use to such teachers, and help to enable them to put their boys in a right way of learning for themselves.

What, then, is the proper position of these subjects in a course of education?

We must first get some clear notions in common as to the nature of the problem before us schoolmasters just at present. We have to adjust and reconcile contending claims. The subjects that press for admission into our schools, and compete for the time of our boys, are reducible to five heads. They are classics, mathematics, science, art, and useful knowledge.

Under the head of *Classics* I include all the *literæ humaniores*; that is, all that brings man in contact with man, and that developes his intellectual capacities on the side on which Plato and Aristotle loved to contemplate him as a *πολιτικὸν ζῶον*. It is one thing to discuss whether this is best done by teaching him Latin and Greek, and another to recognise that this is the highest object of education. It is quite true that we are in contact with nature, commonly so called, and external inanimate objects, from the moment we are born; but so also are we with one another, and any training that aims at fitting man for his social and political relations is assuredly the highest in its aim.†

Mathematical training is quite indispensable, at least to a certain extent. There is nothing so effective in giving quickness and solidity as arithmetic; it is better than grammar, or science, or anything else, and nothing seems to compensate a boy for being ill taught arithmetic as a child. Geometry also gives fibre and muscle, and is particularly desirable in a literary education. But it is perhaps worth saying here that the advantages of prolonging mathematical training beyond a certain very moderate amount seem to me somewhat doubtful. It is a good employment; gives habits of concentration and accuracy, and gives a certain regularity of thought; it makes the mind a somewhat better machine, but does not do much, as far as my own observation goes, to strengthen or open the mind, or to give available knowledge of tools except in the case of a few who possess special mathematical ability. On the contrary, I think a good deal of time is wasted on mathematics by older boys, who often show distinct ability on other sides, but make extremely slow progress in mathematics, while it commands such a small fraction of their attention.

Science does much more than this; it very much widens a boy's horizon, giving him all sorts of ideas and interests and points of view, which he could not attain from his other studies; it kindles the imagination and gives it material, and some branches of it afford an excellent subject for school teaching. Still experience seems to show very decisively that beyond a certain point, either specific talent, or almost exclusive devotion of time, are requisite for the study of natural science. It seems to me, and I doubt not it is equally plain to others, that *many boys do not gain any fresh power from the continuance of a moderate study of it*, such as is implied in the two or three hours a week that can be devoted to it at school. Just when the science begins to be special and technical and professional, then it seems to elude their grip altogether. They are bewildered: it is often not from want of ability, but from want of versitality and orderliness of mind; they could do it very well if they had not so many other irons in the fire. I am sure that this type of mind is very familiar to every schoolmaster present.

Art, in the forms of music and drawing, has strong claims, but it would be foreign to our present object to discuss them. But it makes demands on the time and leisure, and to some extent adds to the distraction of our students.

Useful knowledge is always knocking at our doors. It presents itself in the forms of French and German, and physiology, and the laws of commerce and geography, and the use of tools, &c. And in some of these we must admit it. French and geography, at any rate, are practically indispensable, and though they injuriously increase the number of subjects a boy has to learn, they do give something of training and culture too.

Now, of these five classes of subjects, commercial education presses the last. Its object is to give a certain quantity of available knowledge and skill, and in giving it to give as much training and culture as it can. But the producible results are the first aim. And from its insisting on accuracy, and even drudgery to procure it, it possesses one of the elements of a good education.

And liberal education presses the first. For the only education which claims the title has hitherto been given along with, if not by, the study of literature. Very indirectly, indeed, is it the result of a moderate knowledge of the Latin and Greek languages. It is the outcome of very many influences that have co-operated with direct instruction in these languages, and their history and literature. The most cultivated ranks of society have been almost exclusively, for many generations, educated on these languages; the schools and universities, where culture finds a home, have only lately begun to recognise other branches of knowledge. And so it comes to pass that it cannot be said that the experiment has ever been fairly tried among us, whether or not a good literary and humane education and culture can be given without a study of classical literature.

Many will be found to say that they learned very little at school, forgot what they learned, and have never felt the want of what they forgot. But even these were probably considerably benefited by the indirect culture obtained from the constant association with cultivated minds. Few really saturate themselves with the literary spirit, but these few do very much to refine others.

I am quite sure that this is the first business of our profession as schoolmasters, to hold this truth strongly against all comers, that "humanity," and nothing else, is to be our object. We must make our teaching bear on this, give our best care to the selection of subjects, and the method of teaching, in order to make this teaching more effective. And when I urge the introduction of the sciences at the head of this paper into our course of Education, I wish to make it plain that this is what they ought to be introduced into, and to this they ought to be made to contribute very effectively.

But the problem is not a very easy one, because it seems to involve the enormous evil of multiplying the subjects of instruction, and so frittering away a boy's time with endless distractions. To learn the Latin and Greek languages alone takes a good many hours a week; if the study of a language is to be of any use, it must be painstaking, exact, and laborious, and it would be a very bad classical education if it did not involve history also, and various kinds of composition, and a good deal also of English literature. For it seems that to acquire literary tastes from Latin and Greek models is too difficult for a vast number of boys. It is not only the unfamiliar language, but the unfamiliar thought—the effort of imagination that is required before they can place themselves in contact with the great minds of classical literature; this is the real difficulty which cannot be got over unless there exists a certain susceptibility and potentiality of culture. It is just the same with ancient history; it is too far off, and many wholly fail to project themselves into it, to be directly benefited by the study of either literature or history. And this renders English literature so useful, as supplying to many what they would otherwise not get at all, and as forming a kind of bridge over to those remote and, in some respects, richer regions. But this implies much additional work; it implies fresh reading, fresh subjects of thought, and much criticism, and this additional work is not one of the least of our difficulties, for it implies more *distraction*.

---

* Delivered at the House of the Society of Arts (by permission of the Council of the Society), on the 22d January 1872.

† See Dr. Temple's evidence, Public Schools' Commission Report, vol. ii., p. 312.

For let us see what we have come to. If classical education is necessary for all boys, with the literature and history that it implies, in the Latin, Greek, and English languages —and if some mathematics are necessary, and science and art, and French, and German, and Geography,—we are in imminent danger of not giving our boys what is more desirable than all these, viz., *faculty*. We are in danger— and to a considerable extent the danger has been realized in fact—of weakening the intellectual fibre of our boys by distraction. We must admit that we fail if boys leave us without fire, or strength, or solidity, or faculty, call it by what metaphor we will. And the theory of education that we are drifting into has an undoubted tendency, in the case of the majority, to weaken the little strength they have, to burn out all their fire in a number of little jets, to make the material too soft to bear the finer carving tools; in a word, to sacrifice *faculty*.

Such an education levels up, unquestionably. It furnishes mental pabulum for a large percentage of boys, who would otherwise be nearly starved; but it also levels down, and tends to eliminate the close study of detail, and the *drudgery* that is essential in all good work. I cannot too earnestly express to you my conviction of this fact. It does not do justice to the best twenty per cent. of our schools. They know more when they leave us, but they have less power of acquiring knowledge.

We are, in fact, trying to hold fast to two theories at once; the old theory of *promise*, and the new theory of *performance*. The old theory was to teach within a limited area of knowledge, with a view of giving faculty in acquiring any other branch of knowledge. But the public now are not content with this. They urge that schools may fail, and often do, to give even faculty; and then their sons get nothing. They say that at any rate the faculty may be tested, and more usefully employed. And so we hear now of University examiners for all the higher schools, who are to see what the results are; and apply to us the same test that has been successfully applied to schools of a lower grade. We must understand the meaning of this movement, and the change in the staple of education we are witnessing. It is to give up, to some extent, the old theory of giving faculty, unless faculty is given equally by by a much more varied education, and a constant demand for producible results.

If I did not think this matter one of the very highest importance to us, I should not venture to occupy so much of your time with it. And I have not even yet quite done. I printed a letter on this subject three years ago, addressed to the present Bishop of Exeter, at that time head master of Rugby school, for discussion at one of our masters' meetings at Rugby, which were then of an extremely interesting and valuable kind, and to which I am indebted for some of the remarks made above. Perhaps I may be pardoned for quoting a passage from it.

"The levelling down is due to the distraction caused by a multiplicity of subjects enforced by means of an artful time-table, which secures to every one its due minimum. I wish it to be distinctly borne in mind that there are many boys in the school who are learning Latin, Greek, French, German, and English, and doing composition in three or four of these languages; who are learning arithmetic, algebra, and geometry; ancient or English History, and the history of the Bible; and that they are learning some one of three or four branches of natural science, such as chemistry, or mechanics, or botany, or geology, in a short time to be laid aside in favour of another; and that this is very nearly, though not quite, the case all through the school; and that in general they receive one or more lessons in each of these subjects every week. If boys were but superhuman!

"I am irresistibly reminded of the French method of fattening domestic fowls. The birds, I understand, are brought in succession before a skilful operator, many times in a day, who, with a tube, squirts a small quantity of previously masticated food down their throats. The birds, it is added, seem to like this treatment, and to thrive on it; and they are ready to be killed in a few weeks.

"We have tried this ornithopachynsipaideia: and it has failed.* Yet to go back is impossible. We cannot say that we will not teach any of the so-called modern subjects. Equally impossible is it to give them less time. The day is getting longer, the astronomers tell us, but you are aware that it is a lengthening quite inadequate to meet our immediate requirements.

"I shall propose as a remedy for this distraction to adopt, to some extent, the *successive* instead of the *simultaneous* method of instruction. Granted that all these subjects must be taught, will it not be best to omit some in each division of the school? Our education will have an equally broad basis. Abilities of all kinds will not be less recognized than at present. And we shall gain in concentration and force, and I believe also that the variety in the school course will be in a more stimulating form than it is at present.

"But it will be difficult in the actual working to stratify our education satisfactorily; and I confess I am extremely anxious to see the attempt made while you are still with us. *Absit omen.* But I can commend to you no greater work than to show us how to stratify English higher education."

In this stratification of studies we began to make some progress in the few months that still remained to Rugby of its great head-master. And this is still the problem before our profession, and proved by our experience to be more urgent than ever. My own belief, however, is, that the porblem can only be solved satisfactorily by the exclusion of many subjects from the early course, and bifurcation in the higher. In the early course, as an illustration of my meaning, I should wish to see arithmetic and French and Latin, to be followed by practical geometry and science in the form of lectures in natural history, and perhaps a little practical work in physics, and that then the bifurcation shall commence; the one branch leading to Greek and verse composition, and a mainly literary education, the other to science and mathematics, with Latin and French and English as the literary elements. Neither branch would be encyclopædic; both would be liberal and humane; and between them they would suit the requirements of the great majority of minds. The reformers in education have no programme at present; their apostle has not appeared, but at any rate they ought not to be content till they have got from the Universities an entire recognition of this second branch as a liberal education. The Universities give the crown to all education, and as long as they demand Greek they tie our hands, and condemn us either to exclude science, or to dwarf and cripple it, and to spoil the education of the mass by teaching them too many things. It is only thus that the two courses can fairly compete with one another, when they are on the same level at the Universities, and are taught at the schools by men of equal cultivation.

I have now made it clear what position in a liberal education I conceive ought to be occupied by natural history. It should be common ground for all, taught to young boys before bifurcation has begun, and so taught as to ascertain, develope, and train any scientific powers they may have. These subjects at such a stage cannot be made to give a complete scientific training; it would be pedantic to teach them in strictly scientific order; they must be so taught as to stimulate the thirst for knowledge, to fire the imagination, to open the eyes to the objects and interests of science, and to give a solid body of information which the results of later study may crystallize round. Incidentally, they give the means of teaching the class the orderly arrangement of a subject in their notes, and scrupulous accuracy and clearness of expression.

The range of the subject will depend largely on the teacher; the man is of more importance than his tools. But it will be selected from what the Germans call "Erdkunde," a term with which Huxley has familiarized us. I do not know that there is a better English equivalent for it than natural history, in the widest sense of the words. But it may be well to sketch the contents of these early lessons on science.

---

* Failed, as I explained elsewhere, to produce results commensurate with the industry of the boys, the perfection of the system, and the ability of the head master. Our honour lists at the Universities were not discreditable at that time.

An orrery and globe, and a little astronomy, form the natural beginning. Let the boys make the effort involved in realizing the plan of our solar system, and our earth in space with its atmosphere mantling round it; its kinship to the planets, its relations to sun and moon. These, and some of the common phenomena—day and night, summer and winter, eclipses, and the changes of the moon—form the natural and the old well-established introduction to science. They are still subjects of surpassing interest to every successive generation. They take boys on all their sides—memory, imagination, and reason. They show, as nothing else shows, the connexion of cause and consequence. And there is a genuine and deep satisfaction, a real pleasure of the intellect, which boys attain when they first understand the causes of these common great phenomena. They stand thenceforward on a higher platform. The universe presents to them not a mere wonderland but a reign of law. These are the *literæ divinæ* written in the universe by the finger of God.

Then we pass to the great earth itself, and all its activities; the effects of its still remaining internal heat, its volcanoes and earthquakes, the slow oscillations of level, and the great changes slowly taking place in the familiar outline of the continents and islands, and the proofs still visible of past changes. These things must be well thought out by the class, and illustrated and brought home to them by pictures and specimens. The effect of the attraction of the sun and moon in making tides, and their geological and cosmical action, is a matter that can be to some extent grasped, though so difficult in its complete theory; and is far too important and common a phenomenon to pass by without notice. And then come the complicated consequences of solar heat and light. It is with peculiar interest and pleasure that a boy learns the causes of winds and currents, of trade winds and cyclones, of evaporation and rain, and its distribution on the earth. There is a sense of power obtained by finding out that these great and familiar phenomena are subject to laws, and are not primary facts. And all these are matters, towards which it is only necessary to guide the thoughts of the boys, and they can, with very little help, think them out for themselves. I find it rarely necessary to give a regular explanation of anything, except as a kind of *résumé* of the suggestions thrown out by the class, and successively criticised. Fresh information as to fact must of course be given, when it is seen to be wanted, and not before. And this incidentally gives them a much higher respect for knowledge and the value of facts than they had before. The labours of observers, and mathematicians, and collectors are seen by the class in their true light, as contributing to the store of accurate knowledge in regions more or less accessible to themselves.

The consequences of these activities must then be traced out. And these constitute the principles of Geology. To teach them is not hard; a large stock of pictures, photographs, &c., will be found very useful. We take the work of rain and rivers; their solvent and transporting powers, and straightway the ravine and the waterfall, the rich plain, and the whole river valley, with its wondrous system of drainage, are seen to be the consequences of the familiar forces at work all round us. The work of the sea is easily understood, and behold the map of England is looked at with new eyes; there must be a cause for every bay and headland. The formation of marine deposits, the growth of coral, and Darwin's explanations of the form of coral islands: the ooze of the Atlantic, the work of frost and snow, the glacier and iceberg, the geographical distribution of plants and animals, all are intelligible, and all, if I may so call it, exciting; they excite to further reading and a good deal of thought; they show, moreover, the regions of knowledge; the necessity of chemistry, and meteorology, and astronomy, and zoology is really felt, without being stated in so many words.

And then begins geology proper, a somewhat harder subject to manage, and in which a few scientific-minded boys begin to take the lead. Up to this time, industry, attention, and literary power, general intelligence, in fact, have been the principal qualities required and encouraged, but now there is something more.

One of my former geological pupils made me a water-colour drawing of the Newbold Lias Lime Works in our immediate neighbourhood. It shows a face of rock, some 30 feet high, and 200 feet long, a section of the lower lias. The strata are bent into a curve, though the surface of the ground is level, and there is a small fault running through them. Red sand, containing one or two large syenitic boulders, caps the quarry; the strata themselves are alternations of limestone and the finest laminated shale.

This diagram lasts me for three or four lectures. We begin by finding out what there is to be seen. One sees the curve, another the stratification, another the sand, while a fourth is much more impressed with the men and their trucks than by the geological features of the sketch. It takes some time before the class really sees all that is put before them in the sketch; the denudation, the unconformability, the alternation of strata, the recent drift sand, the fault, the boulders, and it takes still longer before they are able soundly to reason out and satisfy themselves as to the successive depositions, the upheavals and sinkings, the changes of climate, in a word, the proofs of the prolonged working of the forces they had previously studied. But hurry here is fatal. This is the grand lesson of geology, it took the world some thousands of years to learn, it may well take our classes a fortnight.

Of course, a fluent lecturer could point out all this and more in ten, or possibly in five minutes, and would proceed, perhaps, to the subdivisions of the lias and its ammonite zones. But to do so is, I believe, contrary to the very principles of teaching. Few subjects so well admit of the application of Jacotot's principles, which have been brought before you in this place by Mr. Payne, and in few subjects is teaching by these principles so amply repaid. I think it would be difficult for any member of my class to distinguish between what he had found out, and what he had been told in the study of this section of the lias; he proceeds with a confidence in his powers of comprehension—sometimes destined to a disappointment—which is given by solid knowledge of his own building up. This quarry is the foundation of all our geology. I need scarcely say that very many of the class visit the spot, and severely criticise the drawing, which, from the progress of the quarry, is a little out of date. They bring specimens of all kinds; shale, and fossils, and nodules, and stones from the drift, and your real professional geologist, always a collector, begins to show himself.

This forms the nucleus of knowledge, round which everything has to crystallize. The next step is to discuss the section of our Artesian well. We express publicly our gratitude to our enterprising Board of Health, who bored through 1,145 feet of lias and new red marls, and found salt water at the bottom, that rises to about 200 feet from the surface. Happily a complete section was preserved—the only useful result of the boring. From this and the ordnance map we slowly make out the dip of the strata here, and the strange-looking geological map of England is now no longer a mystery. These bands of colour are the edges of slightly inclined stratified systems. The study of the Warwickshire coalfield, which is bounded by faults, gives us another capital study. The drawing of sections through various parts of England is an excellent exercise, and is the only way to learn the geological map.

We then take to rock specimens and fossils; and here it is advisable to introduce a little of the history of geology; and to tell the class something of William Smith and Cuvier, and their respective discoveries. And whatever time remains is spent in going through the strata in chronological order, with the aid of a museum.

It may seem to some that the amount of positive knowledge gained is too little; and indeed it is not much, not as much as would be gained by half the time spent in learning and being examined on somebody's advanced text-book. But from the one system the boy emerges hungry for more knowledge, and his own reading will supply his wants; he emerges with a clear understanding how science grows, and what it is, and has a framework in which he can fit all knowledge he subsequently acquires; while from the other he comes out—perhaps some of my hearers know how he comes out.

I know of no single book which contains all these subjects. The teacher, at any rate, *must* draw his knowledge from many books, and from real, personal knowledge of his subject. Methods of teaching are very important, but the teacher is of far more importance; and no teaching of these or any other subject is likely to be worth much unless the teacher is thoroughly master of his work, has made it his own by viewing it in various lights, and is independent of any text-book, or any order of viewing nature. He cannot be too discursive in his reading or varied in his attainments; and if he is further able to be prosecuting some original work, however humble, in which his pupils can assist him, they will learn more of the true scientific spirit by contagion than they will gather from the most eloquent lectures.

I have spent enough of your time now, and do not intend to say anything about botany. I have, in fact, nothing to say about it that I have not said in one of the Essays on a Liberal Education that appeared some years ago. I will only repeat one request to all who wish to see how Botany ought to be taught; order Le Maoût's "Leçons Elémentaires de Botanique, fondées sur l'analyse de 50 Plantes Vulgaires." (16 francs.) And I am glad to be able to announce that an English work on similar principles, adapted to English flowers, is forthcoming in the "Monthly Packet," beginning with the number for next July.

I do not see any reason for doubting that these subjects are the best for early education, say from the ages of twelve to fourteen. At such an age, chemistry or physics cannot be understood, except in the rarest cases. I know that Faraday expressed an opposite opinion. But Faraday loved the children, and never examined them. These subjects, especially the geological course, as I have explained it, give a solid foundation of familiar facts, which form the basis of subsequent scientific knowledge. And they attract the strongest and finest minds, which is not found to be the case with all branches of science.

It may be urged that this teaching cannot be *thorough*,—that boys will be brought in contact with chemistry, physics, mechanics, mathematics, at an age when they cannot understand them; and the result will be, to turn them out capable of talking *about* a great many things, and knowing *theories* about a great many things, but without the rigorous training necessary to enable them to judge of these theories.

This is, of course, partly true. But it is no objection. The logical order of ideas is not the educational order. A boy learns to read, and make out the meaning of a story-book before he learns grammar, which might be said to precede logically; he reasons before he can learn logic; and so he has to learn a thousand things by experience and observation and reading and conversation, which form the material out of which science grows. The teaching is thorough *so far as it goes*, and it is delusive to suppose that the teaching of mechanics or physics can be made exhaustively thorough to a boy. He apprehends only by comparison of one thing with another; and where experiment takes him out of the range of his experience, there his conclusions are not his own, but his teacher's. These subjects, which may be put aside as mere scientific information, have a double value, stimulative and intellectual, that no one who has not tried them can well estimate. They would plainly be incomplete by themselves; they do not admit, taught in this manner, of the careful study of detail, the minute and painstaking work and drudgery, that makes every science so valuable as an instrument of education. But these subjects claim to enter into the schemes of literary and scientific education; to form a common ground between them; to be science to the men of literature, and literature to the men of science.

The most important question that arises out of the suggestions I have made is this: Is education in science—by which, of course, I mean a real training in chemistry and physics—incompatible with the existing classical education.

As far as my experience goes, it is in the later years of school life. There are always some boys of sufficient general ability to do pretty well, even to the end of their school course, in all the subjects; and it might be said that these, at any rate, gain from the extension of their education. But I have good grounds for thinking that many of them lose strength, as I have explained before, and go up to the University rather wearied, and with a cessation of growth, at what has been called an *ingenistitium*, or wit-stand. There are many more who can do one or the other well, but from trying to do both well, fail in both. I think it will be admitted that some of these are sufferers. Others are large gainers, finding in science the stimulus and intellectual food they need, and even making progress in classics far more satisfactorily than they would if they devoted themselves to classics. If our Rugby experience is worth anything, it proves this—that there exists a considerable proportion of boys who, after the age of sixteen or thereabouts, gain far more from the study of mathematics and science than they do from language. In literature and history they can hold their own against the best scholars, and continue to derive much culture from these parts of their classical work; but most of their work in language is unproductive. It is equally undeniable, on the other side, that there are some boys whose *forte* is language, and whose minds seem hermetically sealed against scientific ideas. After a time, I think they ought to be left to cultivate their own genius on the side on which it exists. We must respect facts.

The problem, then, of bifurcation, not only in schools but in universities, is distinctly involved in the subject before us. If the universities do not admit on an entire equality the one branch and the other, the modern or scientific sides of our schools will consist of boys not going to the universities, and will be a sort of refuge for failures, or for boys whose education is to stop at an early age. Nor, on the other hand, will it be enough for the universities to admit students of both classes, unless our great schools do the same. It may be urged, let some schools admit one and some the other class; and let boys go to one school or to the other, according to their taste. But the taste is not often ascertained till a boy is sixteen, and up to that time the education ought to be nearly the same; and every one knows how impossible it would be, in practice, to turn a boy out of his school at sixteen. I know that our Rugby boys would rather live on the bread and water of grammar than leave at such an age.

Further, the leaving examinations must be organised with a view to bifurcation and not encyclopædism. This is a matter of immediate importance.

Such, then, is the problem before reformers in education,—to modify our existing schemes and institutions till they admit of boys obtaining a groundwork of education, fitting them for progress equally in literature and science, and in itself, so far as it goes, sound, stimulating, and refining, till they admit of boys continuing the study of literature and history simultaneously, while some of them are concentrating themselves on the study of language, and others on that of science; and till they admit of boys of both these classes being equally welcome at all our universities.

2.

The OBSTACLES to SCIENCE TEACHING in SCHOOLS.—A Paper read before the British Association at Edinburgh, Tuesday, August 8th, 1871. By the Rev. W. TUCKWELL, M.A., late Fellow of New College, Oxford, and Head Master of the Taunton College School.

Seven years have passed since the first Public School Commission revealed to us the fact, that from the higher English education natural science was practically excluded; that while in the preceding generations science had extended her empire, explored and annexed new provinces, and made them accessible to all men, education had become narrower than it was three centuries ago. A statement so startling, and made on such authority, could not but bear fruit. The schoolmasters felt the reproach; the press urged reform; full discussion was facilitated by this association, and a most valuable report was made public with its authority; till, in 1868, a second School Commission felt itself able to declare that the majority of the teachers whom it had examined had accepted natural science as part of their school work. But this announcement became less cheering when the evidence supporting it was mastered. It was found that in the opinion of many head masters the needs of the new subject were fully met by the visits of an occasional lecturer, and by the optional attendance of the boys; or that it was delegated to some assistant of no great mark, who, in addition to the subjects which he professed to know, was expected to get up and to teach without thoroughness or aptitude some one branch of natural science which it pleased him to select; that chemistry was taught without a laboratory; mechanics without models or apparatus; physiology without a skeleton, a scalpel, or a microscope. Where thus commenced, school science has naturally languished; hesitation and misgiving have marked from the first the utterances of the masters who introduced it. In some cases it has been condemned and dropped; in many others it has made no progress; and I believe that at the present moment the first-class English schools which teach it fairly and systematically, which honour it with separate masters and with due appliances, and which accord to it its proper time and worthy rank in relation to other subjects taught, can be counted on the fingers of one hand.

I do not think that we can bestow much blame on the head masters. They have inherited, we must remember, an order of tuition some hundred years old, fortified with minute unbroken venerable traditions, looked upon for ages past as the supreme instrument and test of intellectual power, whole and complete in itself, supported by immense experience, worked by tried machinery. Into the midst of their well-mapped, well-proved system is thrust a strange and foreign subject, comprising many branches and demanding multifold appliances, whose value as a mental weapon they have had no means of testing: they are called upon to surrender to this a portion of the time which already seems too short for other work, and to inaugurate a department of school labour over which they can exercise no sort of supervision or control. They ask for guidance in the new arrangements which they are called upon to form; whether any one department is educationally fundamental to the rest; whether sciences of experiment should precede or follow those of observation; what portions of the old course are to be abandoned; how far the Universities, which in many cases stamp the practical value of their work, will recognise such abandonment. They look round for accredited teachers and approved text-books, for enlightenment as to the amount of apparatus and its cost, for details of teaching and of testing, and they look in vain.

They must fall back upon their moral consciousness, for no help is tendered to them from without. I place this helplessness of head-masters first on the list of obstacles which we have to chronicle, and I plead, for the moment, in their behalf almost more than in behalf of science. For their attitude is frank and cordial; they are prepared, as a body, to meet the demands of the scientific public loyally and with all their might. If those who are pressing modern subjects on them will entertain their just appeal, and try to understand their difficulties, they will prove the best auxiliaries science can hope to gain, for they will bring to this new department of their work the same energy and wisdom, the same self-sacrificing impartial zeal, which have already won for them the deserved esteem of the community; but if we fail to work in harmony with them, their want of sympathy and interest will be simply fatal to our schemes.

The fact that our head-masters, mainly appointed to their posts because of excellence in other subjects, cannot themselves teach science, brings into prominence the next great difficulty with which we have to deal, namely, the training and appointment of science masters. In Germany, the candidate for a school-teachership, already bristling with certificates and testimonials, passes a strict examination in his general culture, in his chosen subject, above all in his practical power of imparting knowledge and in managing large classes of boys; nor, however successful under this ordeal, can he be appointed to any mastership, high or low, until he has spent a "trial-year" in the practice of teaching and of governing at some large school under able superintendence. In England, an university degree is the sole and single test; and though a distinguished position in the honour list is undoubted evidence of high intelligence and extensive knowledge, yet that without which these will be useless in his profession, the power of infusing intelligence and communicating knowledge, clearness of delivery, voice, manner, dexterity of manual illustration, ability to attract and to sustain attention—in a word, *teaching power*—is not only not attested, but is in no way provided for or ensured; and thus we are driven to fear that of the few University men whom the present slight demand for masters has induced to graduate high in science, with a view to scholastic life, a small proportion only is qualified to make it attract and flourish in the class-room.

Further, were the supply of science masters unlimited and unexceptionable, their cost is another heavy item for our consideration. They involve in every case entirely fresh outlay; no modification of the existing staff is possible; no master can be detached from other work, or have science tacked on to his own, without sore and manifest injustice on all sides. Yet the first condition of scientific, as of other teaching, is, obviously, the teacher. He must be a man thorough in his special knowledge, and, if his special knowledge is to stick, of the widest general culture. He must not spend all his time in teaching, but must have leisure to prepare his subjects and experiments. He must possess or he must acquire the delicate art of handling many pupils; the force of manner which attracts them; the enthusiasm which puts and keeps them *en rapport* with him; the insight which reads their minds; the tact which can preserve discipline without checking inquiry; the art of adjusting experiment to information; of glancing at that which is obvious; of dwelling on that which is difficult; and, possessing all this and more, he must be well and highly paid. It is fortunate that we should have the opportunity to urge this point at a moment when all the school endowments in the country are melting in the crucible of a school commission. Its commissioners, like the witches in Macbeth, have thrown strange things into their cauldron; may their incantations, like those of Hecate and her sisters, bring to birth a line of kings

> "Who two-fold balls and double sceptres carry,"

teachers who shall rule in years to come over the empire of things as well as words, over the operations and the phenomena of nature as well as over the history and the workings of the human mind.

If the cost of the teacher can be got over, the remaining unavoidable expense is trifling. It ought to be more widely known for how very small a sum sufficient apparatus can be obtained to teach natural history and experimental science. A laboratory can be fitted up for 20 boys at a cost of little more than 20*l.*; while each boy's private stock of glass and test solutions need not cost him more than 8*s.* per annum. Botanical flower-trays, containing 18 bottles, may be bought for half-a-crown; electrometers, telescopes, polariscopes, models of pumps, and pulleys, can be made, after a little instruction, by the boys themselves, who will learn in their construction far more of the principles which they involve than could ever be instilled into their minds by the choicest produce of the shops. And this leads to one word upon the immense value of workshops in a school, not only as bearing upon practical science, but as distinctly fostering mental growth. The class-room is not the only field of culture; nor need bodily activity reign undisputed over the many hours of leisure. Excessive athleticism is one amongst many causes which are threatening to paralyse University life; and during the months when cricket is impossible, or the hours in which it is superfluous, the forge, the turning-lathe, the sculpture-room, the photographic shed come in not only as preventatives against listlessness and mischief, but as revealing to the boys that they have minds as well as muscles, as imperceptible development of taste and the exercise of unlaborious discipline. And what is true of workshops applies also to those other charming accessories of science teaching, museums, botanic gardens, natural history societies. Let it only be remembered that in all these things the hand of the master must guide and not supplant the labour of the boys themselves; that their growth must be organic, springing naturally from scientific work to meet the wants that work suggests; that their creation and their sustenance by the workers is at once a condition of their vitality, and an elevation of their character from playthings into educators.

The action of the Universities upon science teaching is a question of the deepest moment. For good or evil their influence in many schools is paramount. Possessing supreme educational prestige, and dispensing enormous educational rewards, their power is absolute to determine the grooves in which school work shall run. How their influence has been exerted in the past no one requires to be told; those least familiar with their politics cannot but be aware how great a change has passed over them of late. We may not venture to assume, but we shall all rejoice to learn, that in their future legislation, more especially in the important change to which they have been of late invited by the Committee of Head Masters, they will accept suggestions and even invite assistance from those whom science may depute to watch her interests and to urge her claims.

I pass to a grave item in our catalogue of difficulties. Granting that scientific teaching is essential to a perfect education, the anxious question meets us, how is it to be inserted in the curriculum of an established school? We are told that to meet the demands of University competition the highest pressure is already put upon the time and brains of boys; and that if four hours a week are to be accepted as the minimum demand of science, classical work must suffer. And in order to solve this problem, some well-known schools have instituted a system of bifurcation, separating their senior boys into two departments, whereof one learns classics only; the other learns modern subjects, as they are called, quite or almost exclusively. Of course such a separative process does not really help us. If linguistic training is bad without the rationalising aid of scientific study, no less is exclusive science bad, when divorced from the refining society of literature and philology; and an admission that certain institutions stunt particular faculties is oddly followed by a device which causes each to work unchecked. The difficulty must be met fairly, and on premises which scholars as well as savans can understand. It must be met by asking whether, in purely classical schools, no time is wasted; why it is that in the lower forms a boy takes years to master what a clever tutor teaches in a few months at home; why the weapon of analysis, which opens every other chamber of human knowledge, should be discarded in the case of scholarship alone; whether unattractiveness is an inherent vice in Greek and Latin only, or whether, if judicious method wakens pleasure and keeps alive attention, that of itself is not economy of time; whether, lastly, the day has not arrived when Greek and Latin verse-making has not, like many other sweet and graceful things, passed from vitality to survivalism, and may not be allowed to disappear. Shall I shock the taste of any whom I address, if, after having written some thousand Greek or Latin verses in my own school days, I pronounce them waste of time, and protest against them altogether? They do not cultivate the taste, for reverent enjoyment of the beauty of an author's thoughts is excluded by the labour necessary for a feeble imitation of his diction. They do not train the intellect, for all chance of analysing words and sentences is lost in the necessity of wedging lifeless blocks into the forms of a Hexameter or Iambic verse. Except in the case of those in whom the sacred faculty is innate, and whose genius would find fitter scope in exploring the poetical resources of their own literature and language, they constitute a mere mechanical process, exercising hardly more effect on taste, refinement, imagination, than the compilation of a Chinese puzzle. Their elimination from our school systems will be clear gain in itself, and will set free at once a much larger time than is demanded for the prosecution of natural science.

What that time should be I have already ventured from my own experience to hint. The question may continue open till it shall finally settle itself in the gradual adjustment of science to other subjects, but we shall probably all feel that we cannot demand for it at starting less than four hours a week. Of course, also, if it is to be fairly started, it must be compulsory on all the boys; it must involve no extra charge beyond the actual waste of materials in its experimental branches; it must take rank not as subordinate or alternative to what are called the main subjects of a school, but as being itself one of those main subjects, affecting in due proportion the school marks of the half-year, liberated from all those slight but telling signs of inferiority which prescription is skilful to inflict. Nor must the teacher forget that the victory of science over prepossession, and so its rapid establishment as a settled branch of teaching in the future, depends in a great measure upon him. It will have been introduced and accepted on *a priori* grounds; accordingly as it is borne in mind that things, not words, are its subject matter—that observation and reasoning, not memory and imagination, are its field of work—it will approve itself experimentally, and stand by its results.

The character of those results I cannot for a moment doubt. Its practical value, its endless resources, its cultivation of those faculties which no other discipline can reach, will assert for it at once its place as an essential branch of youthful culture. Rooted and flourishing in the schools, it will overflow into their surrounding neighbourhood. It will give birth to local museums, provincial lectures, science classes. It will lay hold of the tradesmen of our town and counteract the tendency which their life exerts to the exclusive worship of material prosperity. It will light up the minds of our women, too often doomed to pass through the years of so-called education with accomplishments exclusively mechanical, and with intellects absolutely untrained. It will invade the intelligence of our clergy, hostile to its conclusions through ignorance, not through conviction, and will teach them how to bridge, by sympathetic knowledge and by common intellectual interests, the gulf which widens day by day between themselves and the community; far from diluting their religious feeling or undermining their religious faith, it will place on broader grounds and sink in deeper foundations their knowledge and their love of God.

I have detained you long enough, and yet I have but scratched the surface of this great subject. But the summary of what I have to say is this: that our schools, in their readiness to establish science, must be aided from without. All questions of funds, of apparatus, of teachers, of selected text books, of co-ordinated subjects, of University influence, of united action, come to the same point at last. We must have central leadership, at once commanding and intelligent, if the introduction of science into our schools is to be simultaneous and effective. The question has passed out of the realm of general discussion; it is ripe, if ever question was, for detailed and practical settlement. There must be within this association, there must be within this room, men qualified in all respects to appreciate the nature of our difficulties, to formulate rules for our guidance, to press our pecuniary needs on those who are for a time the bursars of our educational endowments, to watch and influence the action of the Universities, as on other points, so especially in the projected "leaving examinations." To them I confidently appeal. I appeal on behalf of countless schools, which, ready to admit reform, are helpless to initiate it. I appeal on behalf of those few schools which *have* initiated it, and are endeavouring courageously and honestly, but with little of useful concert, with much of wasted force, to work it out. Let it once be announced to the educational community that a committee of distinguished men, having at heart not merely scientific interests, but the interests of the Universities and schools, has been armed by this association to counsel, to assist, to recommend and to accredit, to harmonise and to combine, to become, in short, the recognised representatives and controllers of scientific education, and they will not lack grateful clients or attain inadequate results. If science is to flourish in the land, preliminary knowledge and training, bestowed with care upon our boyhood, must leave our manhood free for original research. If our English education is to be abreast of continental teaching, one half of our mental faculties must no longer be suffered to lie dormant. To have removed this great reproach, and to have helped this great reform, will be an achievement worthy to take high rank even amongst those splendid services to science and to the community which give glory to the British Association.

3.

On the TEACHING of PHYSICS. By Professor G. C. FOSTER, F.R.S. [Extracted from the "Educational Times," Feb. 1, 1872.]

I do not suppose that it is needful for me to take up any part of your time this evening in trying to prove how desirable it is that the study of Physics should be introduced into schools as part of the regular school-work. If I have rightly understood the task that has been entrusted to me by the Council, it is not that I should *advocate* the teaching of Physics in schools, but that I should point out, as far as I may be able, *how* it can best be taught. But although probably it may be safely taken for granted that all here are agreed that the science of Physics is an important and valuable subject of study, and one which may with advantage occupy some considerable share of the attention of young people during their school course, it will nevertheless, I think, be useful, before attempting to discuss the way in which the subject may be most successfully taught, to give a few moments to the consideration of what the precise advantages are which may reasonably be looked for, as resulting from the study of it; for it is plain that the first step towards deciding what is the best course to adopt in order to attain any object, is to get a clear idea of what it is we want to attain. Moreover, if my judgment with respect to the reasons *why* Physics is deserving of general study should unfortunately differ from that of any of my audience, the statement of my own opinions on the point will, I trust, help to show that what I may have to say with regard to the *mode* of studying it is justifiable from my own point of view.

First, then, I think it may be asserted that whatever useful results proceed from an early study of Physics, are due much more to the mental discipline which is needful for the successful prosecution of the study than to the value, for practical purposes, of the facts stored up in the memory. Indeed, even in the case of the comparatively small number whose special occupation in after life consists in the practical application of physical principles, it is certain—so far as the two things can exist independently, and can be estimated separately—that a scientific habit of mind is of far more value than a knowledge of scientific facts; in proof of which it is sufficient to call to mind that ascertained facts can nearly always be found recorded in books of reference, while only a trained intellect can interpret the lessons conveyed by any new combination of them.

Nevertheless, when we are considering the way in which Physics should be taught, it is essential to remember that the instrument of intellectual discipline, which this study affords, consists in processes of reasoning whose only basis is our knowledge of individual concrete facts, and hence that the teaching of facts must form a great part of our occupation, even when our principal aim is, not to stock the memory with them, but to train the mind by the study of the methods by which they have been demonstrated, and of the inferences that can be drawn from them.

But the relation which it is desirable to maintain between the two essential parts of the teaching of Physics—that is to say, the relative prominence that should be given to what we may roughly call the teaching of facts, and the teaching of theories—will probably become more apparent if we next inquire as to the precise nature of the mental training upon which the educational value of the study of science in general, and more particularly of Physics, depends. Here, however, notwithstanding the importance of the subject, I fear I shall not succeed in being very systematic, or be able to do more than express very imperfectly the ideas which have struck me as being chiefly worthy of consideration in reference to it. For the question is one of great difficulty and complexity—one in relation to which we have rather to estimate tendencies than definite clearly marked results. We do not, for example, find, as a matter of fact, that scientific men, as a class, possess one invariable set of mental characteristics, or that the intellectual differences between them—even when we compare together those who cultivate the same branch of science—consists in the varying degree in which they possess any special habit of mind. But yet it is unmistakably true that there is a considerable difference between the habitual mental attitude of men of science, and that of those who do not usually occupy themselves with scientific pursuits; although it is much easier to recognise the existence of this difference than to say with precision wherein it consists. An additional difficulty, moreover, attending any attempt to estimate the educational value of scientific studies arises from the fact, that the effect of a systematic and long-continued course of training in any scientific subject, except pure mathematics, has never hitherto been tried in this country; so that our scientific men exhibit the results of individual predilections, and what we must call accidental circumstances, rather than the effects of a special system of education. An "educated" man, in the technical sense, has been hitherto, of necessity, a man educated either by means of the so-called "classical" studies, or of pure mathematics. Hence, in trying to put into as definite language as possible an estimate of the educational advantages derivable from the study of Physics, I shall be obliged in the main to be guided by what seems to be probable *à priori*, in view of the nature of the study itself. Proceeding in this way, and without attempting to treat the matter exhaustively, I venture to draw your attention to the following points.

One most important effect, which this study can hardly fail to promote, is the habit of taking general and more or less abstract views of whatever subject is under discussion, whereby I do not at all mean the habit of being content with vague notions, or of being inattentive to details, but rather the contrary habit of taking account of the general condition which results from the co-existence of all the partial conditions of a phenomenon, instead of concentrating the attention upon one or more of them to the exclusion of the rest. The habit of mind that I am referring to may perhaps be described as the generalization and universal application of the notion of a *resultant*, a notion which, at first purely geometrical and confined to direction and velocity, acquires a physical meaning in dynamics, and re-appears over and over again in all departments of Physics, whenever we have to deal with the superposition of actions or effects. This habit, applied to questions of politics or of social economy, leads men, instead of wishing to see their own views at once triumphant over those of their opponents, to inquire what part of the truth it is which appears so plainly to others as to obscure what is so evident to themselves; but unfortunately, while in Physics the test of experiment can in general be readily applied, to show whether we have rightly estimated the resultant tendency, it is far less easy to check our conclusions by a similar appeal in the case of the more complex problems of social existence.

Another closely allied mental habit, namely, that of distinguishing among the details, which a particular phenomenon may present, those which are essential to its nature, from those which are merely the accidents of a special case, can hardly fail to be developed by the frequent exercise which the study of Physics affords in tracing the operation of a general law throughout a multitude of different phenomena, many of which at first sight do not seem to present any common element. The same effect is no doubt produced, in a greater or less degree, by the study of any science; but none tends to produce it to the same extent as the study of Physics, since in no other department of knowledge do we meet with ascertained laws at once as definite and as various as those of Physics.

The strict quantitative character of the principal physical laws, moreover, renders the study of Physics a very valuable discipline in the strict and careful use of language. In fact, it would be difficult to conceive anything which tends more directly to counteract the habit of using words without attaching definite meanings to them, than practice in the description and explanation of physical phenomena, or in the solution of well-chosen physical problems, where every word used loosely or ambiguously is almost sure to lead, before long, to manifest confusion or contradiction. Again, the habit—quite as much moral as intellectual—of taking care not only that our language shall agree accurately with our meaning, but also that our meaning shall correspond, as closely as we can make it, with the truth of nature—or, in other words, that our records of observation shall be strictly faithful accounts of what has been witnessed—is absolutely essential for the successful prosecution of original investigations not only in Physics, but in all departments of science; and a satisfactory method of teaching will make this necessity as apparent to the student of the elements of Physics as to the original inquirer.

The only other point of which I want to speak specially, in connexion with the educational effects of the study of Physics, is its value when considered as a means of *educating the judgment*, or the faculty of drawing true conclusions from the direct observations of our senses. Probably the habit of making minute and accurate observations is likely to be cultivated to even a greater degree by the study of some branches of biological science than by that of Physics; but probably no science affords so good a discipline as Physics in the right interpretation of our observations, or, in other words, in judging of the true nature of their object. For in no other science is it possible to draw such definite conclusions, or to test them so rigorously by experiment, as it is in this.

If we now try to include all that has been said respecting the study of Physics, considered as a mental discipline, under a single statement, we may put it into some such form as the following:—This study tends specially *to develop the power of thinking definitely and correctly;* and this general statement is perhaps better adapted to serve as a guide in the discussion of the method of teaching Physics than the individual illustrations of it that I have tried to give previously. A word or two upon the relation between science and other studies, considered as instruments of mental education, may, however, still be useful.

The power of thinking in general, or mere mental activity, is, like bodily activity, probably more a matter of constitution than of education, and any pursuit which furnishes the mind with ideas seems as likely to stimulate it as any other. The function of education, it seems to me, is not so much to excite increased mental activity as to discipline that which exists, and direct it to the attainment of profitable ends. And the means available for this purpose may be broadly distinguished as two: first, the power of thinking rightly may be cultivated by the study of the greatest and best thoughts of other men, which is the classical or literary method of education; or, secondly, it may be cultivated by actual practice in cases where the truth or falsehood of our thoughts can be unerringly tested, and this is the scientific method of education. Whether, or to what extent, or in what cases, one of these methods is preferable to the other, are questions not now before us.

Taking, then, as our fundamental principle, that Physics is to be so taught as to make it furnish a series of exercises in thinking correctly, it is clear that this implies that it must be so taught as to make the learners *think about physical questions;* and from this it further follows that the first object of the teacher must be to impart clear physical ideas, which can be made the subject of thought. This, however, can only be done by making the pupils get at any rate some part of their knowledge of physical facts through their own personal observation of phenomena. Not only is the knowledge which a boy gets from what he does and sees for himself, far more distinctly impressed upon his memory than that derived from what is told or shown him by another, but it is altogether of a more intimate and personal kind; he feels himself on terms of familiarity with it, so that he can turn it about and apply it to any use that suggests itself, instead of being, as is often the case with what he knows only on the authority of others, afraid to meddle with it lest he should spoil it, or get it wrong side up and be unable to put it right again. In fact, personal observation and experience naturally produce living ideas, whereas our attempts to communicate knowledge by mere statements and descriptions often result in a form of words being committed to memory quite apart from the acquisition of any corresponding ideas by the mind. Moreover, the mere fact of the application of the mind in making observations and experiments ensures its being actively directed to the matter in hand; while listening to authoritative statements is apt to produce a merely passive and receptive state of mind that is by no means favourable to independent thought.

If these views are correct, it follows that a teacher of Physics should not endeavour chiefly to make his pupils receive and remember his statements of facts, but that he should try, as far as he possibly can, to make them learn the facts for themselves, as matters within their own experience. And it is also evident that the facts to which attention should be directed are not what may be called the curiosities of science, about which little more is as yet known than their mere existence, but the facts which have been of most importance, as serving for the foundation of other knowledge, and whose relation to other facts is therefore most fully known. And here it may be noted, that facts which can be brought into relation with what is familiarly known only by processes of mathematical reasoning that are beyond the reach of beginners, are, for the purposes of elementary instruction, to be classed among the curiosities; the value of physical knowledge for such purposes depends entirely upon the completeness with which it can be understood. We should therefore make the smallest possible demands upon the faith of our pupils, and shun as much as possible all necessity for using such phrases as, "It can be shown," "It may be proved," &c. Our object should be, not to try to convince them of the truth of physical principles, but to help them to convince themselves by reasoning upon the facts they have themselves observed. Hence, in choosing practically the particular subjects to be included in the course of instruction, the two following considerations must be kept in mind: first, the greater or less extent to which the fundamental facts of the several departments of Physics can be demonstrated by such experiments as can be performed by the pupils themselves; and secondly, the extent to which the pupils are able to follow the processes of mathematical reasoning needed for the discussion of the experimental results. The first of these considerations is mainly a question of the amount of time and money that can be devoted to the study of Physics; and the second also is to a great extent a question of time, for when we can afford to go slowly enough, it is possible, even for pupils whose knowledge of mathematical technicalities is very small, to make very considerable progress.

It remains for me to attempt the most difficult part of my task—namely, to contribute something towards the application, in the actual practice of teaching Physics, of the principles which the general consideration of the matter seems to show are those which ought to be kept in view. But I do so with great diffidence; for never having had experience in teaching Physics under exactly the conditions which obtain in schools, I cannot but feel that many of my audience would be able to speak upon this part of my subject with greater authority than I can claim. I must, therefore, ask that what I may say upon it may be considered in the light of suggestions merely, and as liable to correction from those who have a fuller knowledge of the conditions of the problem.

Probably the first question which a schoolmaster, who wishes to introduce the teaching of Physics into his school, asks himself, is, in most cases, how much and what kind of apparatus will be wanted? And this question, serious enough when it is only intended that the master should show experiments to the boys, becomes much more important, if the method I have advocated, of letting the boys make most of the experiments for themselves, is to be adopted.

If a whole class of boys are to perform the same experiments at the same time, it is of course necessary to have a sufficient stock of apparatus to be able to give to every two, or to every three boys at most, the things needed for making each experiment. This, however, it would probably, in most cases, be impossible to do, or would be possible only by restricting within very narrow limits the range of work given to the boys. On the other hand, by adopting the system practised, I believe, in some of the American laboratories, the necessity for multiplying very greatly apparatus of the same kind is to a great extent got rid of. Upon this plan, the boys working at the same time are engaged upon different experiments, and, therefore, use different apparatus. Previous to each lesson each working place is supplied with the apparatus wanted for some particular experiment, and the boys, as they come into the room, are told which place they are to go to for that lesson, the place of each batch of two or three boys being changed from lesson to lesson, till all the boys have made all the experiments provided. These may then be replaced by a new set, which again will remain permanent until all the boys have gone through them. The advantage of making the boys circulate instead of the apparatus is obvious.

It is clear that, by this method of working, a given outlay on apparatus will suffice for a much greater variety of experiments than it would provide for upon the first-mentioned method, according to which all the pupils simultaneously make the same experiment. On the other hand, it greatly increases the labour of teaching a given number of boys, for it excludes the possibility of collective class instruction in the details of each experiment. To make it practicable at all, when one master has to deal with any considerable number of pupils, it would probably be needful to give to each group minute written or printed instructions as to the precautions and manipulatory details required for making the experiments assigned to them. Broadly stated, the difference between these two methods of instruction may be said to be, that the first involves the greater expenditure on *apparatus*, and the second on *teaching power*. The choice between them must be decided according to the special circumstances of individual schools.

But whatever arrangements may be adopted for the actual work of the boys, it will be found to be a very useful rule, with regard to the expenditure for apparatus, to confine it almost exclusively to the purchase of what may be called *scientific tools*, that is, apparatus of general utility, such as balances, air-pumps, thermometers, galvanic cells, galvanometers, &c., as distinguished from apparatus contrived to show only special experiments, like most of the things that figure in instrument makers' catalogues. For it should be remembered that, when a result is to be witnessed only by two or three observers close at hand, there is no need for producing it upon a large scale, and the expensive contrivances of the instrument maker may generally be replaced by less elegant but equally serviceable substitutes put together from such things as are usually accessible. And this leads me to remark parenthetically, that a master who wishes to teach experimental physics with success must not be above learning how to solder, to use a file, to drill holes and cut screws, and to use joiners' tools with such skill as he can acquire; nor must he neglect the simpler arts of boring corks and bending and sealing glass tubes. Some kind of workshop, however modest, is a necessary adjunct of a physical laboratory.

Even more important than a judicious choice of apparatus is that of the experiments to be made with them when they are bought. With regard to this point, my own experience leads me to think that merely qualitative experiments are of little use in practical instruction; they do not afford sufficient occupation for either hands or head, and are, therefore, apt to degenerate into play. Simple physical measurements, on the contrary, give plenty to do, and yield far more instruction. For instance, if a boy is told to form an image of a flame upon a screen by means of a convex lens, he will have finished the experiment in less than two minutes, and want to know what he is to do next; but if he is told to measure the distances between flame and lens, and between lens and screen, at which sharp images can be formed, for half a dozen prescribed positions of the screen, and also to measure the size of the image in each case, he has got work enough to keep him attentively occupied for a full hour, and at the end of it he has acquired *data* from which, with a little guidance, he cannot help deducing the principal laws of the action of lenses.

With a little thought there can be no difficulty in finding abundance of easy and instructive measurements of this kind in connexion with each of the main departments of Physics. But in order to make sure that the pupils know clearly what they are intended to do, and also to train them in methodical habits of working, it will probably be found useful to give them, with each exercise that is set them, with each exercise that is set them, a blank scheme or schedule, to be filled up with the results of their measurements, and with whatever further results it is intended that they should deduce by calculation from these. For example, in the case of the experiment referred to above, the schedule to be filled up might be as follows:—*

Distance from					Size of Image.		$P = \frac{A_1+B_2}{2}$	$Q = \frac{A_2+B_1}{2}$	$F = \frac{PQ}{P+Q}$	$\frac{I}{I_1}$	$\frac{P^2}{Q^2}$
Lamp to Screen $= L$	Lamp to Lens $= A_1$	Lens to Screen $= B_1$	Lamp to Lens $= A_2$	Lens to Screen $= B_2$	I_1	I_2					

The first column of this table would be filled up beforehand with the distances to be employed; and the actual measurements would be entered in the next six columns, headed respectively A_1, B_1, A_2, B_2, I_1, I_2. The other columns would be filled up by calculation from the experimental results in the way indicated by the formulæ at the top, and the degree of accuracy obtained would be indicated by the greater or less constancy of the values deduced for the principal focal length of the lens, entered in the column headed F, and by the amount of agreement between the numbers in the last two columns. As a general rule, it should be required that all the measurements should be finished before the calculations are begun.

Although it appears to me to be almost, if not quite, a matter of necessity that some amount of practical work, of which the above may serve as an example, should form part of the course of instruction in Physics, it does not seem to me possible to say, with any approach to precision, how much work of this kind is essential; all that can be said upon this point is, the more of such work the better, for there is no likelihood of what is found to be the practicable maximum being ever as much as is desirable. On the other hand, I think it of the utmost importance that the attempt to introduce practical teaching should not be given up in despair on account of the difficulty or impossibility of introducing it, otherwise than on a very limited scale. For boys who have gone carefully and systematically through even only one or two sets of experiments, are far better able than they were before to understand and profit by experiments which they see performed by their teacher, or of which they merely read or hear descriptions. They have, as it were, become intimately acquainted with one member of a family, and, therefore, do not feel that any of the rest are entirely strangers to them.

---

* The letters and formulæ at the head of the several columns of this table are meant for the guidance of the teacher rather than for that of the pupils, to whom it is easy to explain the calculations they are desired to make without ever mentioning a general formula. But one of the incidental though not least important results of making boys go through the calculations needed for comparing the results of simple measurements of this kind, is the insight it gives them into the meaning and use of general algebraical formulæ. When they have been made to see that a general relation holds good with regard to the numbers resulting from each of several similar measurements, they begin to want some more general language than that of arithmetic for expressing what they have learnt, and are pleased, instead of being puzzled and disgusted, when they are shown that all possible individual cases can be included under a single algebraical formula.

But even with the most complete equipment in the way of apparatus, it does not seem to me to be practicable to teach Physics properly by means of laboratory experiments only. A great deal of additional instruction is needful in order to point out the full meaning of each experiment and the bearing of different experiments on each other, as well as to show what the general laws of physical phenomena are, and how they can be established. This is, in fact, the most important part of physical teaching, and it is rather for the sake of giving reality to it, than for its own sake, that practical work appears to me to be of such very great value. I do not see any way of giving it satisfactorily except the method of experimental lectures, or the reading of a text-book, accompanied by the exhibition of the most important experiments referred to, and by very copious oral comments and explanations. In such lectures it is desirable that there should be as little formality as possible; the teacher should always bear in mind that the first object of all for him to aim at is to get his pupils to *think* for themselves about what he is telling them; and in this case he will welcome all serious questions and interruptions as his best helps. Dogmatism should give place entirely to demonstration. The relation of the teacher to his class should resemble that of a guide, who knows better than the rest of a party the ground that all are to traverse—not that of a traveller, who comes back to show to an admiring audience the wonderful things he has brought from places that they have never seen. The way in which he will best enable his pupils to accompany him will be suggested to him by the recollection of the difficulties which chiefly impeded his own progress in the early stages of his career. Much may no doubt also be learned as to methods of teaching by studying those employed by teachers of experience and of acknowledged success, but no course of previous training can supply the place of actual experience in teaching; without this a man can never know the immense difficulty of imparting to others a clear idea of what is perfectly plain to himself. Nor can he become aware of the difficulties which his own mode of presenting a subject tends to produce in the minds of his pupils. But although I am, therefore, strongly of opinion that anyone who tries to teach according to prescribed rules, instead of being guided by his own experience of success or failure, will never be a thoroughly good teacher, I still venture to ask your attention to a few points, the importance of which—self-evident as it may seem—was not so fully obvious to myself when I first tried to teach Physics as it has now become.

(1.) The most essential of all the conditions for successful teaching is that the teacher himself should have an absolutely clear idea of what is to be taught. It is far from being enough for him to have "got up" the subject carefully from books, and to know exactly what they say about it; he ought to have such a thorough understanding of it as will make him independent of the manner in which it has been presented by others, and will enable him to place his pupils at whatever point of view shows most plainly the connexion between the new subject and their previous knowledge. If the teacher's own knowledge is of the merely "adhesive" kind that exercises the memory apart from the reasoning powers, he cannot expect that his teaching will ever get below the surface of the minds of his pupils, or be of any use for the purpose of training them to *think*.

(2.) In teaching a subject which depends so completely as Physics upon experimental demonstrations, it is needful to be on our guard against letting experiments occupy the place of the principles they are employed to establish, and letting the mechanical details of apparatus obscure the perception of the experiments that are made with them. The kind of fault I refer to is far too common in most of the elementary text-books. For instance, n treatises on electricity, we almost always find one or more chapters devoted to the electrical condenser and Leyden jar, where the construction and action of these apparatus are elaborately described, but in which very often there is no clear statement of the nature of *electrical capacity*, and of the conditions which determine its amount in any special case. Again, we often meet with descriptions of comparatively complex apparatus—such, for instance, as the induction coil, in which the mechanical details of construction are dwelt upon at such length as almost to prevent the reader from recognising the usually simple principles on which the action depends. It is of course needful that the construction of apparatus should be explained so fully that pupils may know what the things that are shown to them really are, and what it is that is done with them when they are used for making experiments; but time spent in discussing mechanical arrangements, which might equally well be modified in a score of different ways, is worse than wasted—it not only hinders, it prevents the comprehension of more important matters.

(3.) In teaching a subject in connexion with which so many ideas and phenomena are met with that do not occur in every day life, and, therefore, are not provided for in every day language, as is the case with Physics, the frequent use of technical terms cannot be avoided; but we ought always to remember that the use of the study of Physics is not to explain such terms, but that the use of the terms is to facilitate the study. In beginning each new subject, we ought to keep completely out of sight all the technical terms relating to it, and should explain in common language, even at the risk of considerable circumlocution, the ideas that these words are intended to express. For instance, we should not begin by talking about *specific heat*, or *electromotive force*, or *indices of refraction*, and then proceed to explain what the term means; but we should first demonstrate the existence of the property in question, and then, after the idea has been grasped, we should give a name to it. In this way, when the word follows the idea, it is understood at once and felt as a help by the learner, instead of being regarded, as it often is when the opposite order is adopted, as something even more difficult to understand than the idea which it ought to convey.

In conclusion, I cannot help saying how fully conscious I am that my lecture has been to a great extent wanting in the practical character which I was wishful to give to it. While avoiding details, which it did not seem possible to discuss with advantage without being wearisomely minute, I fear that my generalities may have degenerated into vagueness, and that I shall not have succeeded in suggesting anything likely to be practically useful to those who have really to do what I have been talking about. However, I have striven to be true to the principles I have advocated; I have tried to give good reasons for whatever opinions I have ventured to express; and, by presenting the problem before us in the clearest way I could, I have endeavoured to make it show the way to its own solution. And if what I have said should lead to a discussion of the methods of teaching Physics among those actually engaged in the work, useful results cannot fail to follow.

4.

On the Place of Geography in Education.*—By the Rev. E. Hale, M.A., F.R.G.S., Assistant Master at Eton.

"I am a schoolmaster—seeking rather for information than able to give it—hoping to awaken such interest in others who are skilled in scientific learning, that they will give the benefit of their ideas and more impartial judgment to its professional teachers, who are the obscure pioneers of what is probably a great educational movement.

"Every man from his birth is brought into contact with his fellow-men and with Nature. Nature and Man should be, and are intended by the Creator to be, in harmony with each other. The great aim of education should be to teach the relations in which each man stands to Man and Nature,—to teach each man in such a way that he should be best fitted to fulfil his social duties, best fitted to understand and employ advantageously the forces and powers of Nature.

"Since the days of the Greek philosophers until quite recently, all those who have taught, have (some perhaps unconsciously) had in view the idea of teaching the pupils their duties as citizens by means of a classical education, a system of education which, including not merely the languages, but also history and human philosophy, was, indeed, a liberal education, although a one-sided one. This was the original aim; but having to commence by teaching

---

* Read before the Geographical Section of the British Association, at Brighton, August 27th, 1872. [Extracted from *The Proceedings of the Royal Geographical Society* for 1872, pp. 450–454.]

Latin and Greek before the great fathers of philosophy could be studied, their education degenerated into a mere teaching of two languages: a teaching, too, not carried on in a scientific or original manner, but by enforcing arbitrary rules of (so-called) grammar, and by exercises in a forced and artificial style of composition; a system which (at any rate where education is confined to it) I contend is calculated to dwarf the mind and impair the reasoning faculty. For the young are naturally inquisitive and eager for knowledge. In our intercourse with our own little children we see that daily. Now, this teaching of grammar—irksome to the majority of teachers, irksome to the majority of learners, preventing freedom of thought or play of intellect —was all the education afforded in our chief schools some 40 years ago. Here and there mathematics were added, but modern languages and science were entirely ignored.

"Recurring again to the aim of education to teach the young their relations to Man and Nature, or rather so to train them that they may be able to learn them for themselves, we see a system of education dividing itself into two branches—Human and Natural Philosophy;—the one taught by Literature and History, the other by Mathematics and Physics and Science. Whether Latin and Greek are the best means for teaching the former of these is not my business now to discuss. But we must bear in mind that school education can be but rudimentary, but must be sound. Boys (and girls, too) should not be turned into superficial sciolists, but should have a good solid foundation given them on which to build their future knowledge. Certain rudiments should be taught them, knowing which, they should be able, branching one way or the other as their faculties or inclinations lead them, to devote themselves to their own peculiar study.

"And these rudiments should be—a Language, either ancient or modern, besides their own; a certain amount of Mathematics, principally Arithmetic and elementary Geometry, or rather, perhaps, Geometrical Drawing—the Arithmetic to give quickness and readiness, the Geometrical Drawing to teach form and shape; and Geography, Political and Physical,—the former being absolutely necessary to the study of the History of Man, the latter—Physical Geography (Erdkunde, as the Germans and Professor Huxley call it, Natural History as Mr. Wilson names it)—being nothing less than the History of Nature, the term by which I, with all due deference, would prefer it to be designated.

"With this groundwork a pupil should afterwards be able to devote his attention more particularly to his own special study. But these things should be taught *thoroughly*. It is impossible to expect a boy of average abilities to learn well many things—it is injurious to him mentally and bodily to attempt it. And yet this is attempted. For I cannot too prominently bring before you the fact that in very many schools where science is taught, it is added to other studies—it has been pushed in forcibly—and often in a most perfunctory manner. One term a boy has a course of Mechanics, the next of Astronomy, the next of Chemistry, and so on. I hold that this is a great evil; injurious to all concerned, pupils as well as teachers. I wish to maintain that a good solid, common foundation—some such a one as I have sketched out—should be given to all; and that then there should be two great divisions in a school,—the one Literary, the other Scientific and Mathematical.

"I hold, then, the first object of school education should be to ground the young thoroughly, not superficially, in those elementary studies which may best fit the pupils afterwards to pursue their investigations into the History of, and the Laws which govern, Man and Nature. And I consider Geography in its broad sense, Political as well as Physical, to be one of these elementary studies, absolutely essential to the proper study of the History of Man and Nature. The upholders of the old system of education admitted this partly. For they made a point of teaching the political divisions of the world in the days of the supremacy of Greece and Rome, and they were glad if, in the nursery or under a governess, a boy had learned the different countries of the world at the present time, and the names of their chief cities. But having myself for many years been a teacher of Modern History, I found boys absolutely ignorant of the commonest geographical facts, unable therefore to understand the political importance of treaties altering the boundaries of countries, or of the exchange of colonies; in fact, so badly grounded that they were unable to use with any advantage Historical Atlases, such as that of Spruner. Obviously a knowledge of Political Geography must precede the study of History.

"But that Physical Geography should be the groundwork of science teaching is not so obvious to all teachers. I ought, perhaps to have said before, that in all matters of practical teaching I advocate nothing that I have not myself personally tried. I spoke before of the inquisitiveness of children; every parent knows it well, and must have observed also how, after school life begins, this inquisitiveness seems to vanish. My own opinion is, that it is generally stifled by the evil genii 'Latin and Greek Grammar.' Be that as it may, I know that this disappearance of inquisitiveness does not prove that it is dead. 'With warmth ' and gentle rains it sprouts afresh.' This stimulating power is afforded by Physical Geography. The first things the teacher will teach are the first principles of Astronomy, —the earth, its position in the solar system, the phenomena of day and night, summer and winter, eclipses and the changes of the moon. Boys generally become interested at once; the intellectual cravings of their very childhood again revive and are being satisfied. At the end of the very first lecture boys will remain behind, asking for further information—'Why is it?' Having then taught the first principles of Astronomy, the teacher will proceed to the first principles of Heat, to the effect of solar heat on the earth, tides, winds, and currents, evaporation and rain. Thence he will proceed to the first principles of Geology,—to the changes in the physical features of the earth, to rivers and ice and volcanoes, to the formation of chalk and coral, to the distribution of plants and animals. And if at first the inquisitiveness of the learners is excited, at the end they first feel their intellectual powers. They see how, from the knowledge of certain facts, the great laws of nature are deduced,—the spirit of the inquirer, of the discoverer, is aroused in them,—their reasoning faculties are now excited and strengthened.

"Of course, generally speaking, boys who are the best in Classics and Mathematics are best also in Physical Geography, because they are boys whose natural abilities are above the average. But there are many exceptions. Boys whose early training has been deficient, or who from some intellectual cause are unable to appreciate the refinements of grammar, suddenly awake, as it were, when first taught the principles causing the phenomena of Nature. And a great moral good is effected in them. I am one of those who hold that sports—athletics—are of use as a means of moral as well as of bodily training, that many a thick-headed, strong-limbed boy, by his excellence in sports is enabled to recover or maintain the self-respect he may have lost, or be in danger of losing; so, in like manner, the boy finds in the study of Nature, and in the fact that he may hold his own in this study, a means of preserving his self-esteem. An objection strikes me may be made against the study of Physical Geography, that it is too discursive. I have insisted on a boy's training being thorough, and at the same time have praised the study of Physical Geography as being introductory to so many sciences. But there is nothing really contradictory in this. The want of thoroughness is seen when boys are successively put through courses of Astronomy, Chemistry, Mechanics, &c. Anything like a thorough knowledge of these sciences, or of any one of them, cannot be imparted to a boy. Astronomy and Mechanics, for instance, if exhaustively studied, require a large knowledge of Mathematics,—much larger than that possessed by the great majority of boys. But the first principles of those sciences necessary to the study of Nature, such as Astronomy, Heat, Geology, Zoology, may be thoroughly taught, and can be perfectly understood by a boy of fair intelligence. Again, discursiveness is not opposed to thoroughness, and the discursiveness of Physical Geography is a positive advantage to the teacher. One of the great benefits which a large school affords to boys, is that they are brought into contact with so many different minds, they are subjected to the influences of so many different teachers. So the science teacher who is instructing his boys in Physical Geography will naturally dwell at greater length on his own *specialité*, will bring much peculiar knowledge to bear in illustrating all those natural phenomena which relate more particularly to his own branch of science. And on this I found another reason for making Geography or the History of Nature the foundation of all science teaching in schools.

"I will briefly mention the method I employ in teaching Physical Geography, premising that I by no means insist on it as the best method. I have had good results from it, but doubtless a better method would have produced still better results. At the same time, I must claim this indulgence for science teachers from adverse criticism. Classical teachers have the experience of centuries to guide them. The method of science teaching in schools must be regarded as tentative; as I before said, the teachers of the present day are but the pioneers of the educational army which will eventually, I believe, overcome the ignorance of 'common things' displayed so universally, and put to flight the host of Philistines who rejoice that their children's intellects are kept in the same state of bondage as their own.

"My class consists of about 30 boys. I give them no *text book;* and on this, I may say, I place great importance. Each boy has one of Keith Johnston's School Atlases of Physical Geography, price 10*s.* 6*d.* The teacher, I presume to be conversant with Humboldt, Herschel, Tyndall, Murchison, and Reclus; and to know Sir C. Lyell's 'Principles' thoroughly. My references are principally to these authors, and my 'stock-in-trade' consists of wall maps, photographs, and a microscope in my study for the more eager pupils. I ought to have also a good geological museum. This is at present in course of formation, and when the school authorities will grant a suitable room, will be speedily in working order. I require each boy to bring in a large note-book, with each page folded in the middle. I commence my lecture by stating first what is the more immediate subject of my lecture; then I dictate from my own notes an abstract of the first division of my lecture—this abstract each boy writes on one half of the folded page. I then enlarge and illustrate by facts, putting at the same time frequent questions to the boys. On the other half of the page each boy takes as many or as few notes as he pleases. At the end of the lecture, which lasts somewhat less than three quarters of an hour, I refer the pupils to authors, and the chapters of their books which treat more at length of the subject. Only the more industrious boys refer to these. If possible, I show a photograph or picture of some well-known or often described place, which may serve to illustrate the lecture. After my two lectures (two lectures are given weekly) I require each boy to bring an abstract of the lectures, not copied verbatim from his note-book. I give marks for these, and also additional marks for good diagrams. After every eight or ten lectures an examination paper is set, and I give a prize to the boy whose aggregate marks for abstracts and papers are highest.

"I feel that a most valuable addition to my lectures would be some kind of field instruction—such as I hope to hear mentioned by the President—which should include the teaching practically the use of instruments—and also should admit of those excursions, geological, botanical, or zoological, so common in German schools.

"Now, I believe, that independently of the knowledge acquired by the boys, the mental training is by no means despicable, which shows them, first, how to analyse a lecture or a book, as the abstract dictated to them does; and secondly teaches them, as their original abstract does, how to reproduce in their own language the lectures they hear. And this is part of the thoroughness of teaching which I insist on.

"One other objection I have heard urged against Geography, that it is a subject easily 'crammed up,' I may here answer. The result of competitive examinations is doubtless to encourage a system of cramming. If a pupil is not intended for a competitive examination, I hold that my method is the farthest possible removed from cramming; but if a pupil be intended for a competition, the question arises will he be able to pass well. I have faith that he would, and the only two competitive examinations pupils of mine have gone in for they have done satisfactorily. But I hold that Geography, if the examination papers are set with the same discrimination as those set in the Royal Geographical Society's examinations, cannot be crammed up. There are two great desiderata in an examination paper: first, to give problems; secondly, to give full marks for a certain portion of the paper answered well, *i.e.*, to encourage a thorough knowledge of some parts of a subject. Fortunately, then, Geography is so discursive; and fortunately problems can be set.—Given certain conditions, what will result?—Given certain facts, what laws would you deduce? But my own experience teaches me this—that Mathematics admit of more 'cramming' than any other study; and yet who would refrain from examining in Mathematics, because they admit of being crammed? I trust the time is not far distant when every boy in those schools professing to lay the foundations of a liberal education will be at least as conversant with Geography, both Political and Physical,—the one the necessary introduction to the History of Man, as the other is to the history of Nature—will, I say, be as conversant with Geography, as they now are supposed to be with the Latin Grammar."

5.

PRACTICAL REMARKS on the TEACHING of PHYSICAL SCIENCE in SCHOOLS. By the Rev. W. TUCKWELL, M.A., Head Master of the College School, Taunton, and late Fellow of New College, Oxford; with Letters from Charles Daubeny, M.D., F.R.S., late Professor of Botany, and late Professor of Chemistry in the University of Oxford; Henry W. Acland, M.D., F.R.S., Regius Professor of Medicine; and John Phillips, M.A., F.R.S., late Professor of Geology.

Ought Physical Science to be taught in schools? and if so, under what conditions, as regards the age of the pupils taught, the proportion of time assigned, the apparatus and accessories required?

The claims of science to be regarded as a necessary element of education have been urged by every scientific man of eminence in the kingdom. The one-sidedness of existing culture, and the manifold defects which this one-sidedness involves; the injury inflicted by it on those many minds which display peculiar aptitude for physical science rather than for languages and mathematics, and its neglect of those faculties of all minds which only physical science can call forth; the peculiar excellence of science as cultivating in a way attainable by no other means the habit of observation, of reasoning on external phenomena, of classification, arrangement, method, judgment; its power of exercising the memory at the same time that interest is excited and knowledge gained; its practical value as a preparative for professional or general life; to the medical man, the engineer, and the agriculturist, as bearing directly, in one or another of its branches, on their daily work; to the soldier as creating in him the power to appreciate and to record the phenomena which beset him in the distant countries which, at one time or another, he is sure to traverse; to the clergyman, as diminishing that dangerous want of sympathy between the clergy and the working classes which is due chiefly to the absence of a common ground of feeling, to mutual ignorance, and disregard on either side of those subjects which each severally knows and values; to all men, of whatever rank or occupation, as furnishing an endless resource of exquisite enjoyment; as lighting up the dirt on which they tread, the weeds and the insects of their walks, the daily phenomena of the sky and air, with a beauty, a history, a suggestiveness, which educates, refines, and purifies as much as it refreshes and delights. All these points are pressed upon as eagerly by the leaders of education and of thought, while the opposing arguments of critics unacquainted with the subjects which they denounce, appear calculated to cause amazement rather than to enforce assent.

But while all whose opinion is valuable are agreed upon the educational worth of science, and lament the injury inflicted on the country by its omission from the curriculum of our schools, no one, so far as I am aware, has come forward to furnish information as to those questions of detail whose settlement is of necessity preliminary to any practical effort at amendment. At what age, for instance, ought the study to be commenced? In what sequence should its various branches be taken up? How much time in each week must be allotted to it? What apparatus is necessary for its prosecution? It is with unfeigned diffidence that I offer suggestions on these several points. My acquaintance with school teaching, and my studies of physical science, have been long enough to teach me, amongst other things, my own exceeding ignorance; but having for some years included physical science in my course of teaching, and being about to introduce it systematically into my present school, I offer to all whom it may concern the results of personal experience.

As regards the age suitable for commencing scientific studies, I can affirm that I never met a schoolboy too young to derive enjoyment and benefit from them. The faculty of observation is perhaps the earliest faculty developed, the habit of inquiry concerning things observed the earliest habit formed. I know a child of six years old who can pull a flower to pieces and tell the names of its component parts, and who pronounces unhesitatingly the titles of the larger portion of the insects, plants, and minerals which present themselves in her daily walks. We have heard of the classes taught by the late Professor Henslow, in his Suffolk parish, where boys and girls of humble life, from eight to twelve years old, gained under his instruction, readily and voluntarily, a respectable knowledge of botany; and many persons must have witnessed the intense delight perceptible in quite young children, while the common objects of a country walk have been judiciously explained and illustrated by a well-educated governess or friend. I can say without hesitation that a boy's scientific studies may begin from the time when he is first sent to school.

The order in which scientific subjects are to be taken, and the time to be assigned to them, may be discussed together. It is generally considered that these three subjects, Natural Philosophy, Chemistry, and Physiology, are educationally fundamental to all organic sciences. The first of these may be considered to include the properties of bodies, mechanics, hydrostatics, hydraulics, and pneumatics, optics, and acoustics. I have never found the slightest difficulty in teaching these subjects, treated not mathematically but experimentally, to boys of twelve years old, and I have known many boys of eleven quite capable of understanding and remembering my lectures. For boys, then, younger than eleven, I would form a junior class, which should devote one hour in the week to some such book as the well-known "Guide to Knowledge," or to some "Catechism of Common Things." The text book chosen is of no great importance, if the teacher can be trusted to expand and illustrate each lesson by verbal explanation, or by the assistance, if necessary, of a microscope and air-pump, or other interesting instrument.

With a considerable knowledge of facts, and a keen appetite for information and experiment of a higher kind, a boy would at eleven or twelve years old enter the Natural Philosophy class, spending on this new topic two hours in each week, and completing in the next two years the course of subjects ranged under this head. At thirteen or at fourteen years he would be ripe for the chemistry class. He would now witness and perform experiments in the laboratory, and would study the laws of heat, of the non-metallic elements, of the atmosphere, and of water. By attendance during two hours in the week, with opportunities of repeating or verifying experiments out of school hours under the master's eye, he would in the course of a year have completed his course of inorganic chemistry, and be prepared at fourteen or fifteen to enter the Physiology class. He would here be first taught the physiology of man and of the higher mammalia; and thus familiarized with the principal organs and their functions, would start from the lowest point of animal life, and ascend by a course of comparative anatomy once more to the highest.

He will by this time be 16 or 17 years old, a period at which many boys leave school. Should he stay till 18 he will have an opportunity of studying either geology, mineralogy, vegetable physiology, or botany, or of entering upon organic chemistry; but even if he leaves school at the age of 16, he will have acquired in five years, at a cost of less than two hours a week, a body of information and a practical familiarity with the fundamental laws of science which will have furnished him with lifelong resources, and developed, as I believe, to an amazing degree his mental powers. And side by side with his severer studies the less laborious pleasures of science will have been presented to him. In many a country walk or half-holiday excursion he will have learnt the delights which wait upon the enthusiastic naturalist; and as years go on, the crowded shelves and cases of the school museum, the well-stored botanic garden and herbarium, the carefully-compiled and published Fauna and Flora of the district, will bear witness to the judgment that has won to innocent and refined enjoyment the restless natures which, if left unguided, might have been wasted and lounged away in the billiard-room or stable-yard.

For the effective teaching of these various subjects an extensive apparatus is essential; without models, instruments, and specimens, nothing whatever can be done. If bought in the shops the cost of these accessories is alarming; but with the help of a dexterous carpenter and glazier the great majority of them can be manufactured at a trifling cost. In my own school a class-room with an area of about six hundred feet has been set aside for our small museum; the walls will be lined with deal cases between seven and eight feet high, having moveable shelves, and divided into compartments for rocks and fossils, anatomical and zoological specimens, philosophical instruments, and models. A working table for the microscope, with a microscopic cabinet, and drawers for insects and mollusca, will be added as our funds permit. An adjoining room will form our laboratory, while half an acre of ground has been laid out as a botanic garden so as to hold about six hundred plants. I calculate that the necessary cost incurred at starting, for cases and shelves, for instruments and models, and for the laying out and labelling the garden, will be covered by 60*l.*, a sum which I have little doubt that the kind liberality of the neighbourhood will principally furnish. The pleasure of collecting plants and specimens, of mounting preparations and preserving objects, will be reserved for the boys and masters; and by their help and by the assistance of our friends, I have no doubt that we shall possess in a few years' time a collection numerous enough to be completely typical, but whose limited extent will enable the individual specimens to exhibit extraordinary excellence and beauty.

Amongst the first and kindest contributions to our scheme are the interesting letters from distinguished Oxford teachers which I am permitted to append to this short paper. The time to come will show whether the predictions which they utter, and the hopes which I have built upon my own experience, are founded well or ill. Without their warm support I should not have ventured to come forward, and I have the satisfaction of feeling that those who find my own remarks uninteresting will thank me for eliciting theirs.

I will presume, in conclusion, to express a hope that the nascent study of physical science in our schools may be fostered by the labours and the recommendations of the present Educational Commission. The results of those labours are awaited by a very different class from that which owned an interest in the Public Schools Commission, and will be criticised in a very different temper. The Procrustean system of our public schools is viewed with languid disapproval at the most by those who entrust their sons to them in order that certain tangible prizes may be won, or by that far larger class who reckon extravagance, exclusiveness, and idleness not hard conditions towards the attainment of gentlemanlike manners and the acquisition of fashionable acquaintance. But thousands of hard-working anxious parents, who know the wealth of knowledge and of mental training, and whose worldly and professional experience has led them deeply to distrust a plan of teaching which they consider narrow, partial, unelastic, and unpractical, will eagerly expect and thoughtfully peruse the opinions which shall be expressed, and the verdict which shall be delivered, by those to whom the regeneration of the great mass of English education is committed.

LETTER from DR. DAUBENY.

MY DEAR SIR, April 15th, 1865.

I AM glad to learn that you are designing to introduce the study of physical science and of natural history into the school under your superintendence.

I am persuaded that a certain acquaintance with these subjects might be imparted generally to boys, without interfering with those classical acquirements which had heretofore constituted the staple of an English education.

Different heads of study are to the mind what different kinds of exercise are to the body, and by bringing into play new faculties enable the student to refresh his mind with intellectual occupation of another sort, even when wearied and disgusted with the ordinary routine of school-boy employments.

Besides, since the great object of classical study, as an element of general education, is to develope the faculties, it must be apparent that similar effects will be produced by the acquisition of a knowledge of the laws and phenomena of the external world, especially in quickening the sources of observation, inducing habits of method and arrangement, exercising the power of induction, &c.

Moreover, as it must be admitted that only a certain proportion of any number of youths are capable of appreciating the niceties of scholarship and the higher beauties of the classical writers, it will be well that an opportunity should be afforded them of acquiring other kinds of knowledge, which may take the place of that for which they possess neither the genius nor the inclination.

It is, therefore, not without reason that physical science has of late been allowed a place in the *curriculum* of our universities, and that scholarships as well as fellowships have been instituted for its encouragement.

Judging from those which have been established in my own College at Magdalen, I should pronounce that the experiment has hitherto proved *eminently* successful.

At any rate, there can be little doubt that through those influences, and that of the honours now held out at Oxford for proficiency in these studies, a knowledge of the physical sciences will become more extended and more generally appreciated amongst the educated classes than has been the case hitherto.

The encouragement given to these branches of learning at our universities has indeed already begun to act upon the public schools; and many private academies and colleges also throughout the country have, with great advantage to themselves and to their pupils, introduced these branches of knowledge into their courses of study. And as only a part of the boys therein educated commonly resort to the universities, it is evident that acquirements which admit of so many important applications to the purposes of life must be well worthy of being cultivated, by all at least who profess any natural bias or aptitude for them.

I am persuaded that if physical science and natural history were introduced more generally into schools, side by side with the classics, we should hear much fewer complaints as to the number of dunces sent into the world after the completion of the ordinary years of study.

Botany especially seems adapted for a school recreation, for one does not see why boys should not exercise that quickness of sight and observation which is characteristic of their age, in the discovery and discrimination of the flowers that present themselves to their view, as well as in the ordinary sports in which they indulge.

On every account, therefore, I wish you all success in your proposed scheme, considering it conducive both to the general interests of education and to the credit and prosperity of the school itself, both as a preparative for the universities and for other walks of life.

I remain, dear sir,
Very truly yours,
To the Rev. W. Tuckwell. CHARLES DAUBENY.

LETTER from DR. ACLAND.

DEAR MR. TUCKWELL, Oxford, April 24th, 1865.

I HAVE great pleasure in sending a small donation towards your projected collection of apparatus for teaching the elements of natural science in the Taunton School.

No one conversant with the state of culture in Europe can doubt, I think, that the youth who have in early life some sound training in the direction of science are placed in a situation more advantageous than those who have not. The chief difficulty appears to be in deciding what they should learn at school, and who shall teach them.

Both these questions are no doubt in some cases (and as yet in country schools in England in the majority of cases) insoluble. In the case of Taunton neither difficulty arises. In you the school has a master himself accurately instructed in some departments of natural knowledge; and, therefore, not only capable of selecting what shall be taught, but of teaching himself, and judging of teachers.

My general feeling on the whole question (as you are kind enough to ask it) is that the *matter* taught is very secondary in importance to the *manner*. The essence of science lies in observation, comparison, and classification; in precision of data and precision of argument.

These several qualities can be more or less elicited from every department of natural science by a competent person imbued with the scientific spirit in any branch.

For boys, of course, the simpler subjects are the best. The ordinary laws of Physics come first no doubt in order of study, then Chemistry, then the several departments of Biology. Some boys would prefer chemical subjects and experiments, some botany or British zoology, with the physiology of plants and animals. Indeed, if I were to venture to suggest a course for any school, it would be to have on hand one of the inorganic and one of the organic class of subjects at different times of the year, and to let the boys choose their class. It is probable they would choose both.

I hope you will be successful in obtaining the "plant" you consider to be necessary for starting, and I shall hear at any time with gratification of your progress.

I am, dear Mr. Tuckwell,
Ever yours faithfully
To the Rev. W. Tuckwell. H. W. ACLAND.

LETTER from PROFESSOR PHILLIPS.

MY DEAR SIR, Oxford, May 1st, 1865.

THOSE who knew and profited by your zealous cultivation of natural science in Oxford, will hear without any surprise, but with great pleasure, that your thoughts have been turned to the introduction of this order of study into the course of instruction in your grammar school. Even if you were not moved by considering the actual inducements now held out by your university and several colleges for the advancement of physical science, the singular local advantages of your beautiful district—the garden of England—would surely lead you to indulge your own love of botany and zoology and palæontology, and to fill the minds of your pupils with the delightful images of natural beauty and divine wisdom and goodness which these branches of study call up. Remembering how marked an influence on my own life a few words addressed, a small microscope given to me at school, really exercised, I resume with pleasure my old status of a student, and will try to explain how, according to my experience, schoolboys may acquire with least pressure, with most pleasure, and with the greatest profit, that kind of knowledge of natural science which will be of great value in after life, and, if they come to the university, will give them a place among their rivals from which to spring to higher grades.

The knowledge to which I refer is the knowledge of *things;* not a store of reading about plants and animals, or chemical wonders, or astronomical vicissitudes, but recognition of animal and vegetable forms; some idea of the peculiar adaptations of teeth and bones to the diet and movements of animals; experiments tried with the air-pump; minute objects seen by the microscope; planets and stars and sun and moon examined with the telescope. In short, that which is the most important for the efflorescent mind is the opportunity of observation:

> "Give him to *see*, the schoolboy asks no more!"

But to furnish this opportunity, so that the boys may have frequently before them the objects most worth observing, you must have a museum. Yes, a museum! Not such a collection as many busy towns and many idle gentlemen possess—"spoils from every land, trifles from every sea"—but a small, well-arranged selection of natural objects—minerals, rocks, fossils, skeletons, skulls, insects, &c., all preserved with respectful care from mischief, decay, and dust. More than this, a very small laboratory—that is to say, a work table and a couple of drawers for tools and chemicals, and a few instruments for experiments, such as thermometer, air-pump, electrical machine. I would limit these treasures to a single room, and would give in that room not anything like a lecture, but easy and familiar explanations in answer to questions, or as a necessary accompaniment of experiments. How much more is learned of plants by gathering them with a botanist at hand, than by hearing dissertations on "botany" from the professional chair! How much fitter for a boy is the guinea and feather experiment than the "theory of gravitation;" one peep through a telescope, than the "laws of dioptrics and catoptrics;" the burning of iron in oxygen, than the "atomic theory!" These laws and theories they may fully master in after years, and all the more easily, that they have seen some of the characteristic phenomena while the eyes are bright and the doors of memory are open to new impressions.

Yes. You must have a museum, and it will be in your hands an instrument of power, a means of permanent good as well as an ever-renewed pleasure to your pupils. You ought not to refuse aid in filling it, for your purpose is of more than local or personal interest. I beg permission to offer you three little contributions: a fossil, typical of natural history; a thermometer, representative of experimental science; and a sovereign, which may help to glaze your drawers or cabinets.

And now I resume cap and gown, and go to teach my own class, amongst whom in future years, perhaps, I may count one or two of your pupils.

Ever yours most truly,
JOHN PHILLIPS.

The Rev. W. Tuckwell, M.A.,
College School, Taunton.

The METHOD of TEACHING PHYSICAL SCIENCE in SCHOOLS.—A Paper read before the British Association at Exeter, August 21st, 1869. By the Rev. W TUCKWELL, M.A., late Fellow of New College, Oxford, and Head Master of the Taunton College School.

The claims of Physical Science, on *à priori* grounds, to a fair place in the course of school work, have been abundantly vindicated, and are, I suppose, established. But the method and details of its teaching, the books and apparatus which it requires, and the amount of time which must be given to it, are points which can be decided only by experiment, and have not yet been decided at all. I cannot premise too distinctly that the aim of this paper is practical. Of the necessity for teaching science to their boys many good schoolmasters are convinced; as regards the machinery by which it is to be taught, they mostly confess their ignorance, and cry aloud for guidance. In my own school it has been taught systematically for the last five years, and I offer the fruit of this experience, very humbly, to all who are interested in education.

The subjects to be taught, the time to be spent upon them, the books and apparatus necessary, and the mode of obtaining teachers, are the points on which information seems to be required. I will take them in order.

The subjects which naturally suggest themselves as most essential are Experimental Mechanics, Chemistry, and Physiology. But it has been urged by high authority, familiar to the members of this Association, that between Chemistry and Physiology, Systematic Botany should be interposed, as well because of the charm this science lends to daily life, as from its cultivating peculiarly the habit of observation, and illustrating a class of natural objects which are touched indirectly or not at all by the other sciences named. Whether all these four subjects can be taught depends upon the period to which school education is protracted; but, at any rate, let these, and none but these, employ the hours assigned especially to Physical Science, in the scheme of actual work in school. Abundant opportunity will remain for less direct instruction in many other branches of science. The geographical lectures, if properly treated, will include the formation of the earth's crust, with the classification and distribution of its inhabitants, both animal and vegetable, both extinct and recent. The possession of meteorological instruments, whose observations are regularly taken, and their computations worked by the boys, will almost insensibly teach the principles of atmospheric phenomena; while such books as "Maury's Physical Geography of the Sea," "Airy's Popular Astronomy," and "Herschel's Meteorology," may be given as special matter for annual scientific prizes. The laws of light and heat will be taught as prefatory to chemistry. Electricity attracts boys so readily that with very little help they will make great progress in it by themselves. The mathematical master, whose best boys are well advanced, will not be satisfied till he has obtained a transit instrument and a mural circle. And the wise teacher, living in the country, will not disdain to encourage a knowledge of natural history. He will know that it is not only ancillary to severer scientific study, but in itself a priceless and inexhaustible resource. By country walks, by well-chosen holiday tasks, by frequent exhibitions of his microscope, he will not only add to the intellectual stock of his boys, but will build up safeguards to their moral purity. Indeed, even without such encouragement, boys who are trained thoroughly in certain sciences will of their own accord seek to become acquainted with other and collateral ones. Cases multiply in my own experience where pupils of a chemistry class have taken up electricity, pupils of a geography class mineralogy, pupils of a physiology class microscopy, and I need hardly say that boys make nothing their own so thoroughly as that which they select themselves.

The time to be given to science should not be less than three hours a week. At this rate two years may be given to mechanics, two years to chemistry, one year to botany; while the rest, if any remain, will be free for physiology. We need not be afraid of beginning early. A boy of 11 years old, fresh from an intelligent home, where his love of observation has been fostered, and his inquiries have been carefully answered, is far more fit to appreciate natural laws than a much older boy, round whose intellect, at an old-fashioned school, the shades of the prison house have steadily begun to close. Most schools are now divided into lower, middle, and upper. I would commence the study of mechanics with the junior class in the middle school. For the first year the teaching may be *vivâ voce*, with easy problems and abundant experiment; care being taken that each week's lectures shall be reproduced on paper, and great attention being paid to correct drawing. In the second year the teaching will be more minute and more extended, and a good book will be mastered. At the end of this time the class is fit to pass creditably the Oxford Local Examination for juniors, and has done with mechanics for the present. The third and fourth years will be given to inorganic chemistry. The third year will include only lectures in the class room; a text book being used, experiments being shown by the master, but no laboratory work being done by the boys. The fourth year's work will be conducted entirely in the laboratory, each boy manipulating with his own instruments at his own table. At the expiration of these two years the class will be qualified for the chemistry examination in the London University Matriculation. The fifth year is given to botany. If a good book is used, if each boy works for himself with lens and knife, if "Henslow's Schedules," or a modification of them, are regularly filled up; above all, if plates are not made to do the work of living plants, the pupils will at the year's end thoroughly understand the principles of classification, will know the characteristics of at least all the British orders, and will be able with the help of Bentham or Babington to make out almost any English flower. The boys who have completed this course will be from 16 to 17 years old. Some of them will now be leaving school; those who will remain will give the rest of their time to physiology. They will begin with human and will pass to comparative physiology, using in the first Professor Huxley's valuable little book; dependent for the second, of which no school manual exists, on the skill and method of their teacher. But whether at the earlier or the later age, they will pass out into the world immeasurably superior to their contemporaries who know not science, with doors of knowledge opened which can never again be closed; with a fund of resource established which can never be exhausted; with minds in which are cultivated, as nothing else can cultivate them, the priceless habits of observation, of reasoning on external phenomena, of classification, arrangement, method, judgment.

The subject of books and apparatus, involving as it does the question of expense, is of the highest practical importance. Apparatus need not cost much; but it may, and, if possible, it should cost a great deal. While poor and struggling schools may begin cheaply and proceed gradually, institutions which can spend money on racket courts and gymnasiums ought not to grudge it on museums and botanic gardens. We have taught mechanics efficiently, that is to say, we have passed our classes for the last three years in the Oxford Local, with a good air pump, a set of pulleys, models of the force pump, and the common pump, with Keith Johnston's scientific maps, and with the diligent use, during the second year, of "Newth's Natural Philosophy." But we have lost no opportunity of making the boys acquainted with machinery; from the crane and the water-mill of our daily walks, to the steam engine and the spinning jenny of the manufactory; for he who has not examined engines at work will never understand them clearly, or describe them correctly. For teaching chemistry a laboratory is absolutely essential; no matter how rough or shabby a room, so that it be well ventilated, have gas and water laid on, and will hold from 16 to 20 boys. I hold in my hand the model of a cheap laboratory table, on the scale of two inches to a foot. It is about 9 feet by 3, and contains eight compartments, each 2 feet by 16 inches, with two slight shelves, and a special recess for the teacher. It costs about 4*l.*; if made for twice the number of boys, it may be made at about 9*s.* per boy. The general laboratory stock, including a still, a stove, or furnace, gas jars, a pneumatic trough, a proper stock of retorts, crucibles, tubing, &c., and the necessary chemicals, will cost under 12*l.* Each pair of pupils must have also between them a set of test tubes, a washbottle, a spirit lamp, a waste basin beneath their table, and 24 bottles of test solutions, while each boy has his own blow-pipe, tripod and stand, pestle and mortar, and three beakers. These will cost each boy about 8*s.* He will replace everything that he breaks, and will receive the value of his stock from his successor when he quits the class. The text book used should be Roscoe's or Williamson's, and a large black board is quite indispensable. In botany the book for the boys' use is Professor Oliver's Lessons; but the teacher will find great advantage from Le Maout's Leçons de Botanie. An excellent modification of Henslow's Schedule is published by Professor Babington for the use of his Cambridge classes, and Lindley's Descriptive Botany, price 1*s.*, is a most useful help. Every boy should be furnished with a small deal board, a lens, and a sharp knife. The botanical microscope which I exhibit, including a lens fixed or moveable, a black glass stage, two dissecting needles and a forceps, is made by Mr. Highley, of Green-street, Leicester-square. If they are ordered by the dozen, he will furnish them at 6*s.* each. Flower trays, such as I hold in my hand, should be kept constantly in use; the boys being encouraged to bring in wild flowers, and to place them in their appropriate niches. Their cost per tray, holding 18 bottles, is under 2*s.* Fitch's diagrams, designed for the Committee of Council on Education, which cost 2*l.* 9*s.* the set, are a valuable help to the lectures; and for schools which have large purses or liberal friends, Dr. Auzoux's models of plants and plant organs, ranging in price from 20 to 100 francs, and 10 times the size of life, form a luxurious assistance to beginners, which only those can appreciate who have worn out their eyesight and their temper over a composite floret or the glume of a small grass. The same excellent modellist, whose catalogue is on the table, provides every organ necessary for the study of comparative and human physiology; and his prices ought not to be beyond the reach of any prosperous school. In any case a skeleton will be necessary, and will cost about 5*l.*; and if the Committee of Council were to authorize the reproduction of such typical physiological cases as, from the skilful hands of Mr. Charles Robertson of the Oxford Museum, drew so many admirers in the Exhibition of 1862, these would find immediate purchasers in many of our schools. At present teachers want the skill or the leisure to make their own preparations, and they cannot buy them. A good set of meteorological instruments costs from 16*l.* to 20*l.*, but these, with astronomical apparatus, are a costly luxury, and may be left out of the list of indispensable necessities. I cannot think that any school, professing to teach science systematically, will be long satisfied without a typical museum. As scientific work proceeds, specimens of all kinds, some purchased for lecture work, others given by friends or collected by the boys, will gather and increase, till the class-room cupboards and shelves are choked, and a special room must be devoted to them. Here will be arranged, in one place rocks and fossils, in another trays of minerals, in a third zoological specimens, in a fourth physiological preparations. The driest corner in the room will be assigned to the Herbarium, a small library of scientific reference will give promise of the future. Everything not typical will be rigorously excluded; every case will be so carefully arranged and so plainly labelled as to tell the history of its contents to the eye of the least instructed observer. And it will be hard if some corner of the playground cannot be laid out as a botanic garden. In the crowded school premises which we are happily leaving I have found room for nearly 400 plants, and at the new school to which we are about to migrate I shall riot in two acres of garden ground, with a pond for water plants and a sheltered rockery for ferns.

It remains only to examine the mode of obtaining teaching power; a point which presses heavily on many head masters who have themselves no knowledge of science. That all head masters should have such knowledge, is a fact which, if science is to be taught at all, trustees and governing bodies must come to recognise before long; meanwhile every school which teaches science thoroughly, is training skilled teachers for a not distant generation. Institutions which can give so high a salary as to command a London bachelor of science or a first-class Oxford or Cambridge man, will find no more difficulty than attends the choice of all masters: where this is not the case, it is sometimes possible, by combining mathematics with physical science, to tempt a superior man with a sufficient income; and if only a small salary can be given, the ordinary pass B.A. of the London University will sometimes make a fairly good teacher. But one point has struck me forcibly in my own experience; namely, the unexpected value of general culture in teaching special subjects. The man who knows science admirably, but knows nothing else, prepares boys well for an examination; but his teaching does not stick. The man of wide culture and refinement brings fewer pupils up to a given mark within a given time, but what he has taught remains with them; they never forget or fall back. I am not sure that I understand the phenomenon, but I have noted it repeatedly.

I cannot end this paper without a word as to the educational results which our five years' experience has revealed. The system has brought about this result first of all, that there are no dunces in the school. In a purely classical school, for every promising scholar, there are probably two who make indifferent progress and one who makes no progress at all; and a certain proportion of the school, habitually disheartened, loses the greatest boon which school can give, namely, the habit and the desire of intellectual improvement. By giving importance to abstract and physical science we at once redress the balance. Every boy progresses in his own subject; some progress in all; no one is depressed, no one thinks learning hateful. Secondly, the teaching of science makes school work pleasant. The boy's evident enjoyment of the scientific lesson rouses the emulation of other masters. They discover that the teaching of languages mav become as interesting as the teaching of science. They realise—a point not often realised—the maxim of Socrates, that no real instruction can be bestowed on learners "παρὰ τοῦ μὴ ἀρέσκοντος, by a teacher who does not give them pleasure." Lastly, the effect on the boy's character is beyond all dispute. It kindles some minds which nothing else could reach at all. It awakes in all minds faculties which would otherwise have continued dormant. It changes, to an extent which we cannot overestimate, the whole force and character of school life both to the learner and the teacher. It establishes as matter of experience what has long been urged in theory, that the widest culture is the noblest culture; that universality and thoroughness may go together; that the system which confines itself to a single branch of knowledge, does not gain, but loses incomparably, by its exclusiveness; that observation, imagination, and reasoning may all be trained alike; that we may, and so we must, teach many things, and teach them well.

II.—CATALOGUE OF APPARATUS FOR THE TEACHING OF PHYSICS AND OF INORGANIC CHEMISTRY, WITH PRICES ATTACHED.

(*See* § 20.)

PHYSICS.

SOUND.

Apparatus.

	£	s.	d.		£	s.	d.
1 table air pump	2	0	0	to	13	0	0
4 receivers, of which 1 open at top, ground flat 1 shallow	0	12	0	„	2	15	0
A true brass plate for receiver of air-pump, with straight adjustable rod through it	0	10	6	„	0	15	0
1 musical box, small size	0	10	6	„	1	1	0
A double square case, padded, 1 ft. × 1 ft. × 1 ft.	0	18	0	„	1	0	0
12 solitaire balls 1 grooved board for do.	0	12	0	„	0	15	6
A tuning fork on resonance box. Prongs of fork, 1 ft. long	2	10	0	„	5	0	0
Box of musical glasses	0	5	0			—	
12 varnished pith balls	0	1	0	„	0	2	6
1 tin funnel with side tube. 1 pint	0	2	0	„	0	2	6
Sounding box, 1½ ft. × ft.	0	12	0	„	0	15	0
8 bars of equal length of glass, brass, and woods, each 5 ft. long and ½ in. diam., vizt.:— 2 glass. 1 mahogany. 2 brass. 1 larch. 1 deal. 1 oak.	0	15	0	„	2	0	0
Tinned iron tube, 15 ft. long, 9 in. wide, in three pieces, to fit one another	1	0	0	„	2	0	0
A whirling table, with screw clamps to fasten on table	2	10	0	„	6	10	0
Harmonic toothed wheels to fit on whirling table	1	1	0	„	2	10	0
Brass collar to fit on whirling table (to clamp perforated cardboard disks)	0	2	6	„	0	10	0
2 wooden laths, 6 ft.	0	2	0	„	0	7	0
1 rectangular steel wire, 4ft. long, ⅛ in. square	0	2	6	„	0	5	6
2 forks for sinuosities with scratchers	0	16	0	„	1	5	0
6 selected forks on resonance boxes	5	0	0	„	5	10	0
1 set of Wheatstone's rods and bent rod	1	5	0	„	1	10	0
Barrett's compound spring	0	5	0	„	2	0	0
1 kaleidophone	1	5	0	„	1	10	0
4 Lissajou's forks with compensator	10	10	0	„	12	0	0
A 4-keyed wind box	5	10	0	„	10	0	0
1 table blow-pipe, complete	5	0	0	to	6	6	0
1 monochord on sounding box, with moveable spring balance attached to pull, 4 cwt.	2	2	0	„	7	10	0
1 brass alarum bell	0	6	0	„	1	10	0
A set of Chladnis plates with clamp, two bows	2	2	0	„	3	3	0
Brass bar clamped in centre, with suspended ivory ball (18 in. long). For longitudinal vibration	1	16	0	„	3	0	0
3 hoops of gutta percha, 18 in. diam. 4 in. deep	2	0	0			—	
2 blackened brass disks, 1 ft. in diam., with connecting brass tube, ⅜ in. thick, 4 ft. long	0	15	0	„	1	7	6
5 resonant zinc tubes, from 3 ft. to 6 in. in length, 2 in. diam.	0	7	6	„	0	15	0
1 spiral steel spring. Close spiral, 2 ft. long, 1 in. diam.	0	2	0			—	
A Baden-Powell's wave apparatus	3	0	0	„	6	10	0
A double gas jet. (Singing flames)	0	12	0	„	1	10	6
2 pressure gas bags, with pressure frames and nozzles. 4 gallons' capacity	2	0	0	„	7	0	0
6 organ pipes corresponding with forks	1	15	0	„	2	2	0
An organ pipe fitted with glass side	1	0	0	„	1	1	0
Organ pipe fitted with gas side cell and membrane (nodes)	1	15	0			—	
1 pitch pipe	0	5	6	„	0	7	6
3 reed pipes	0	15	0	„	1	5	0
Dissected embouchure of organ pipe	0	5	0	„	1	4	0
1 trumpet organ pipe	0	10	0	„	0	15	0
A model of human larynx	0	7	6	„	1	0	0
A single syren	4	0	0	„	4	4	0
An anatomical model of human ear	4	4	0			—	

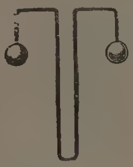
Materials.

	£	s.	d.		£	s.	d.
¼ oz. Lycopodium	0	3	0			—	
2 lb. white sand 2 lb. black sand	0	1	0			—	
3 bladders with stop-cocks	0	9	0	„	0	18	0
160 yards steel pianoforte wire, selected of three kinds	0	7	6			—	

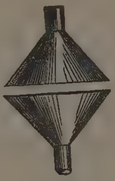
HEAT.

Apparatus.

	£	s.	d.		£	s.	d.
2 brass and iron gauges and holes -	0	10	0	to	1	0	0
1 hollow brass sphere and ring (for expansion) -	0	9	0	,,	0	15	0
Fergusson's pyrometer - - -	1	15	0	,,	4	10	0
Trevelyan's rocker - - -	0	12	0			—	
Apparatus for comparative expansion of liquids; viz., a tin trough 18 in. long, 6 in. wide, 6 in. deep - - -	0	5	6	,,	0	7	6
1 air thermometer - - -	0	1	6	,,	0	15	0
1 differential thermometer - -	0	17	6	,,	1	18	0

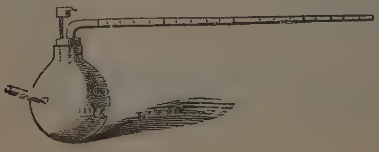


	£	s.	d.		£	s.	d.
1 model of Siemen's pyrometer - -	0	0	0	,,	0	0	0
1 ditto Daniell's ditto - -	5	0	0	,,	5	10	0
Compound band of copper and iron rivetted (for unequal expansion), 18 in. long, 2 in. wide - - -	0	7	6	,,	0	15	0
Compound ribbon of silver and platinum	0	7	6	,,	1	0	0
Apparatus for breaking cast-iron pin by contraction of iron - - -	0	7	6	,,	0	15	0
12 Rupert's drops - -	0	1	0	,,	0	2	0
14 selected thermometers, viz.: 1 alcohol from 50° to × 120° F. 2 mercury from 50° to + 100° C. 2 mercury from 50° to + 360° C. 6 mercury from 0° to + 360° C. 1 maximum and minimum - 1 maximum - - 1 minimum - - -	3	5	0	,,	5	0	6
An iron bar 2 ft. × 1 in. + 1 in. -	0	5	0	,,	0	7	6
A copper bar 2 ft. × 1 in. × 1 in. -	0	15	0	,,	0	18	0
12 wooden balls, 2 in. diameter - -	0	4	0	,,	0	10	0
Cylinders for conduction of heat, viz.:— 2 copper 1 iron 1 lead 1 zinc 1 bismuth 1 antimony 1 box wood 1 marble 1 ivory 1 in. diam., 1 in. high	0	10	0	,,	1	10	0
Ingenhouz's bars (for conduction) with trough - - - -	0	15	0	,,	1	5	0
Apparatus for showing conduction of heat by liquids (Guthrie's) 2 copper-cone bottles on stand, with screw adjustment - - -	1	10	0	,,	11	0	0

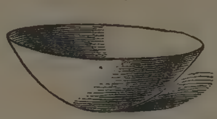


Diam. of base, 3 in.

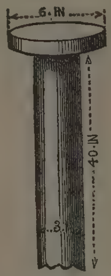
	£	s.	d.		£	s.	d.
Davy's lamp - - - -	0	7	6	,,	0	10	6
1 bell jar 1 ft. diam., 14 in. high, with opening at top and divided chimney. (Ventilation.) - - -	0	10	0	,,	2	5	0
Circular slabs of metal of equal weight and equal diameter (variable thickness), 1 in. diam., viz., iron, zinc, lead, bismuth, antimony, tin, copper -	1	0	0	,,	1	5	0
7 balls of metal of equal size, viz., 1 in. diam. - - - - - Iron, zinc, lead, bismuth, antimony, tin, copper - - - -	0	12	0	,,	0	15	0
Siemens' copper ball pyrometer, 2 in. diam. - - -	4	10	0			—	
Steam jacket calorimeter, with silver cup and small thermometer and cage, complete - - -	1	10	0			—	
Mercury calorimeter - - -	1	10	0			—	



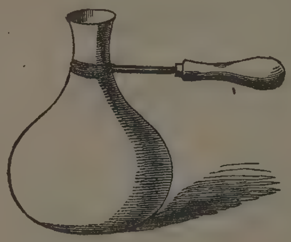
	£	s.	d.		£	s.	d.
Spiral bulb thermometer, mercury, of thin glass for calorimetry, from 20° C. to 200° C. - - - -	0	10	0	to	1	5	0
Pure silver evaporating dish, 4 oz., 5 in. diam. - - - -	1	10	0	,,	2	7	6



	£	s.	d.		£	s.	d.
6 porous capsules for freezing under air-pump - - - -	0	4	0	,,	0	6	0
1 condensing syringe - - -	0	6	6	,,	0	15	0
1 Daniell's hygrometer - - -	1	17	6	,,	2	2	0
6 barometer tubes - - -	0	6	0	,,	0	15	0
A copper well for barometer tubes, with wide mouth - - -	1	0	0	,,	1	15	0



	£	s.	d.		£	s.	d.
A wooden stand for a series of six barometers (vapour tension) - -	0	15	0			—	
1 Marcet's boiler - - -	4	10	0	,,	6	0	0
1 water hammer, with constricted neck	0	3	0	,,	0	4	6
1 cryophorus, 2 ft. long - - -	0	6	0	,,	0	8	6
1 copper boiler, silvered inside, to expel cork (spheroidal state), with handle, 4 in. high - - - -	0	12	6	,,	0	15	0



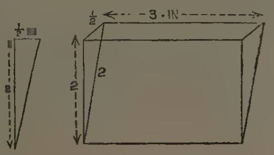
	£	s.	d.		£	s.	d.
Model of Savary's pump - -		—				—	
A pair of silvered reflectors, 15 in. diameter, on stands - - -	2	2	0	,,	10	0	0
4 Leslie's cubes, 6 in. × 6 in. × 6 in., with assorted surfaces; one with glass window 3 in. × 3 in. in one face -	0	16	0	,,	1		
2 tinned iron plates, 1 ft. × 1 ft., on stands, with 2 bismuth bars soldered on centres - - - -	0	15	0	,,	1	6	0
4 saucepans, cylindrical, 1 quart -	0	6	0			—	
Double screen with opening for diathermancy, and support - - -	0	10	0			—	
1 plate of alum - - - -	0	2	0			—	
1 plate of rock salt - - -	0	5	0			—	
1 plate of glass, square, 3 in × 3 in. × ½ in. - - - -	0	1	0	,,	0	5	0
1 hollow copper tube for hot oil, 5 in. × 5 in. + 5 in. - - - -	0	2	0			—	
Wide open iron tube for gas diathermancy, with opening and stop-cock in middle, 4 ft. long, 6 in. diam. -	0	12	6	,,	1	10	0
Model of Joule's mechanical heat equivalent apparatus - - -		—				—	
A pyrheliometer - - -	3	0	6	,,	4	4	0
1 lb. asbestos - - - -	0	3	6	,,	0	5	0

LIGHT.

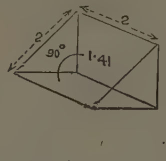
Apparatus.

	£	s.	d.		£	s.	d.
Argand lamp and lantern, with condenser and reflector diaphragms, &c. (Ladd's model) - - -	4	0	0	,,	4	10	0
Electric lamp with fittings. Dubosq's electric light - - - -	12	0	0	,,	21	0	0
ivory balls, from the size of a billiard ball to 1½ inch diameter, pierced through - - - -	1	5	0	,,	2	10	6

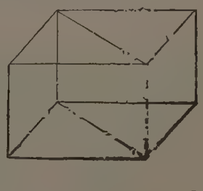
	£	s.	d.		£	s.	d.
Paraffin lamp with chimney and diaphragms	0	10	0	to	0	12	0
Tube camera with pierced diaphragm	0	5	0	,,	0	15	0
Adjustable slit with screw movement	0	15	0	,,	1	10	0
2 tin trays, 4 inches deep; one 4 in. × 4 in.; the other 16 in. × 16 in.	0	7	6	,,	0	10	0
A platinum wire (spiral), ½ in. long, to be incandescible, with 4 Groves; with connecting wires and binding screws	0	10	0	,,	0	15	0
2 ground-glass globes with necks; one 4 in., the other 9 in. diameter	0	12	0	,,	1	5	0
A wire frame to show diminution of intensity by radiation. Law of inverse squares	0	10	0	,,	0	18	0
A black wood tube, rectangular, 4 in. × 4 in., 1 foot long, with moveable end of ground glass; to be set at any inclination to axis	0	13	0	,,	0	15	0
A Wheatstone's photometer	1	15	0	,,	2	10	0
A Bunsen's photometer (a black lath 2 metres long, graduated from each end and numbered. A moveable frame for holding paper screen)	2	10	0	,,	3	10	0
A strip of compound reflector, 6 in. × 4 in.; lower half electro-silver mirror, upper half plate glass, ground and blackened at back	0	10	0			—	
Box for repeated reflexion, 2 ft. long, 3 in. high, 5 in. wide; the slides black wood; the top and bottom of silvered glass. Open at both ends	1	0	0			—	
2 plane mirrors, hinged on long edges, with flush edges, forming a "book mirror," each 6 in. × 6 in.	0	7	6	,,	0	18	0
A Hadley's sextant. (N.B.) To be had secondhand	5	0	0	,,	6	0	0
1 concave silvered glass mirror, 9 in. diameter, on heavy stand, with adjustments for height and inclination	2	10	0			—	
Good silvered glass plane mirror on stand (thin glass). Double movement: (1) to be raised and lowered, (2) to turn on horizontal axis, 6 in × 6 in.	1	10	0	,,	2	10	0
A semicircular black tin tray, 2 ft. diameter, 4 in. deep; glass window in centre; moveable radial arm below tray and outside it; gas lamp and shade, with slit to stand on arm; moveable graduated sine arm	2	10	0			—	
A thick slab of glass with polished faces, to show lateral displacement of oblique beam, 4 in. × 3 in. × ¼ in.	0	1	0	,,	0	2	6
A wedge (narrow prism) of glass, to show lateral displacement with small chromatism	0	18	0	,,	1	0	0



	£	s.	d.		£	s.	d.
2 rectangular isoceles (½ square) prisms; all surfaces polished. Hypothenuse 2 in., length 2 in.	0	10	0	,,	1	10	0



	£	s.	d.		£	s.	d.
1 camera lucida	1	0	0	,,	2	10	0
1 glass cell with glass ends, 6 in. × 2 in. × 4 in.	0	12	0	,,	0	15	0
1 prism with moveable glass sides, to show total reflexion from surface of contained water; 4 in. edge	7	10	0			—	
4 finger glasses of white glass	0	8	0			—	
A couple of flint and crown glass prisms, forming an achromatic combination; each moveable, vertically, and round a horizontal axis. About 2 in. acute edge	1	10	0	,,	2	2	0
A set of model lenses; plano-convex, &c.	1	5	0	,,	1	10	0
4 selected large lenses:	8	0	0	,,	9	0	0
2 plano-convex.							
2 convexo-convex.							
6 in. diameter. Adjustable vertically, and on horizontal axis.							
1 hollow glass lens for holding bisulphide of carbon, 9 in. diameter. Adjustable vertically, and on horizontal axis	5	0	0			—	
1 set of variously excentric diaphragms for lenses (annular, circumferential, central)	1	0	0			—	
Anatomical model of eye	4	4	0			—	
1 ophthalmoscope	0	15	0	to	1	10	0
A disk with one slit, rotating in front of a disk with several slits	0	10	0			—	
A reflecting stereoscope with selected slides including geometrical figures	2	10	0	,,	3	0	0
A refracting stereoscope with selected slides	0	5	0	,,	0	15	0
A pseudoscope	2	0	0	,,	2	5	0
3 hollow optical prisms for bisulphide of carbon	1	10	0	,,	2	11	0
A rotating board with prismatically coloured segments; with multiplying action, to be used by hand	0	7	0	,,	1	5	0
A rotating disk of prismatically coloured glasses, to be used with lamp	0	7	6	,,	2	10	0
12 square, 9 in. × 9 in., coloured glass plates	0	12	6	,,	1	0	0
2 medium blue							
2 deep blue							
2 deep red							
1 deep crimson							
2 yellow							
1 deep violet							
2 purple							
4 glass cells on wooden stands for solutions, 6 in. × 4 in. × 2 in.	2	2	0	,,	2	8	0
A ½-pint metal spirit-lamp with large wick	0	5	0	,,	0	12	0
An achromatic lens. The lenses separate in screw frame, 3 in. diam.	1	5	0	,,	2	2	0
A day telescope	0	10	6	,,	2	10	0
A night telescope	0	15	0	,,	2	10	0
1 Ramsden's eye-piece	0	14	0	,,	1	0	0
1 Huygen's eye-piece	0	14	0	,,	1	0	0
1 opera glass	0	10	0	,,	2	10	0
A model to illustrate the reading microscope	0	15	0			—	
1 plane and 1 convex glass, with pressure frame for Newton's rings, 4 in. diam.	0	18	0	,,	2	10	0
Strained hair with telescope for diffraction							
Frame and polarising glasses, with graduated circle	1	7	6	,,	4	10	0
Board with pivoted frame, for analysing plates (polarisation)	1	0	0			—	
Quartz plate	0	8	6	,,	0	15	0
4-sided pyramid of black glass, on white screen and stand	1	6	0	,,	2	0	0
2 tourmalines in pincers	0	15	0	,,	1	10	0
2 tourmalines on caps for lamp	0	15	0	,,	2	0	0
1 Nicol prism on cap for lamp	1	0	0	,,	2	0	0
4 specimens of Iceland spar, cut, not mounted, 2 in. × 2 in. × 2 in.	2	0	0	,,	3	0	0
Prism of Iceland spar for single and double refraction	0	8	6	,,	2	10	0
Rhomb of Iceland spar, with ends of optical axis ground perpendicularly	0	19	0	,,	1	15	0
Polarising microscope, to fit lamp	10	0	0	,,	12	0	0
Polariscope for lamp	5	5	0	,,	14	0	0
2 pressure frames for strain on glass. (1.) Compression. (2.) Distortion. (Polarization)	1	0	0	,,	2	2	0
Unannealed plates of glass	0	1	0	,,	0	16	0
Bar of glass for vibration, 6ft. × 4 in. × ¼ in.	0	5	0	,,	0	16	0
1 polarising saccharimeter	4	0	0	,,	21	0	0
A spectroscope, with train of three prisms	15	0	0	,,	20	0	0
12 carbon cylinders for burning metals	0	12	0	,,	0	18	0
1 square glass cell diagonally divided	1	0	0	,,	1	10	0



	£	s.	d.		£	s.	d.
1 magnesium lamp	2	5	0	,,	3	0	0

Materials.

	£	s.	d.		£	s.	d.
3 flour dredgers	0	3	0			—	
1 lb. magnesium ribbon	8	8	0	,,	8	10	0
1¼ lb. Canada balsam	0	3	6	,,	0	7	0

	£	s.	d.		£	s.	d.
2 quires tissue paper	0	1	0			—	
60 yards stout covered copper wire for full force of 50 cells Grove	0	18	0	to	1	10	0
5 lbs. mica in cakes	2	10	0			—	
5 lbs. selenite in cakes							
½ pint glycerine soap solution	0	2	0	,,	0	10	0
½ lb. bone ash	0	0	6	,,	0	1	6

ELECTRICITY.

Frictional Electricity Apparatus.

	£	s.	d.		£	s.	d.
12 agate cups for support	1	10	0			—	

Size, about.

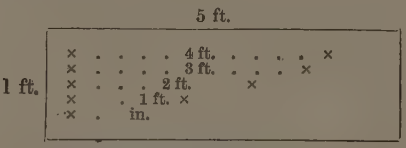
	£	s.	d.		£	s.	d.
3 circular brass plates, rounded edges:—							
(1.) ⅛-in. thick, 12 in. diam.	0	18	0	,,	2	2	6
(2.) ⅛-in. thick, 8 in. diam.							
(3.) ⅛-in. thick, 4 in. diam.							
2 gold-leaf electroscopes, with tops, each 18 in. high	0	15	0	,,	6	0	0
1 Thompson's electrometer							
1 small electrophorus	0	7	6	,,	0	15	0
1 Coulomb's electrometer, with mica plate, and glass for sulphuric acid	3	3	0	,,	3	10	0
1 Pith ball electroscope	0	3	6	,,	2	2	0
A mahogany stool, with glass legs, 1 ft. square	0	10	0	,,	0	18	0
2 cylindrical conductors, on varnished glass legs, 18 in. long, with holes and plugs	2	10	0			—	
3 wooden balls, covered with foil, 9 in. diam.	0	10	6	,,	2	0	0
4 wooden ditto ditto 4 in. diam.	0	6	0	,,	1	5	0
1 ice pail	2	5	0			—	
2 brass balls on bent wire and stand	0	7	6	,,	2	2	0
1 ball 4 in. diam.							
1 ball 1 in. diam.							

	£	s.	d.		£	s.	d.
Ball and covers, with insulating handles, vizt., ball, wooden, coverd with foil	2	10	0	,,	4	10	0
Covers, brass (distribution), diam 1 ft.							
Electric wheel	0	4	0	,,	0	10	0
1 cylinder machine. (Cylinder, 18 in. long, 12 in. diam.)	4	0	0	,,	10	0	0
1 plate glass machine (plate 2 ft. diam.) with hoop condenser	6	0	0	,,	12	0	0
1 Holz's machine (plate 20 in. diam.)	7	10	0	,,	21	0	0
1 brass plate condenser (plates 9 n. diam.)	1	0	0	,,	2	0	0
1 electrophorus, 15 in. diam.	1	0	0	,,	1	15	0
1 dissected jar	0	10	6	,,	0	15	0
4 jars, 1 ft. high, 8 in. diam.	1	1	0	,,	6	0	0
4 insulated table stands, 6 in. diam., adjustable for height	1	4	0	,,	2	0	0
1 spiral ebonite jar, Guthrie's	1	0	0	,,	1	18	6
1 unit jar, about 5 in. long, 1 in. diam.	0	18	0	,,	1	6	6
1 model of Wheatstone's revolving mirror	1	10	0			—	
1 table for spark discharge for ditto	1	10	0			—	
1 disk, with black cross, to revolve. (Duration)	1	0	0			—	
A table universal discharger	1	0	0	,,	2	5	0
Tube for exhaustion and electric discharge, to screw on to air-pump, 3 ft. long, 4 in. diam.	2	5	0	,,	3	3	0
Discharging rod, jointed	0	8	0	,,	0	11	0
Jar, with foil device, 9 in. high, 5 in. diam.	0	12	6	,,	1	1	0
Franklin's plane, 1 ft. × 1 ft.	0	5	0	,,	0	10	0
Open Leyden jar, of thick glass, for self-discharging, 9 in. high, 6 in. diam.	0	10	0	,,	1	0	0
4 Gassiot's tubes, viz:—							
1 air vacuum	1	10	0	,,	2	0	0
1 nitrogen ditto							
1 hydrogen ditto							
1 carbonic acid ditto, 9 in. long							
3 tourmaline crystals, 2 in. long (for pyro electricity)		—				—	

	£	s.	d.		£	s.	d.
3 flat coils for induced spark. Thin covered copper wire coils, 1 ft. diam.	3	0	0	to	4	0	0
1 steam boiler (1 gallon), with nozzle and valve, on tripod stand, and ring burner	5	0	0			—	

Voltaic Electricity Apparatus.

	£	s.	d.		£	s.	d.
1 galvanometer, Astatic needles, flat, 8 in. long, with screws, stops, shade, &c., complete	3	0	0	,,	3	10	0
Thomson's galvanometer, with mica plate (Barrett's modification)	3	0	0			—	
2 commutators	0	12	0	,,	2	2	0
1 large astatic needle, with coil (for strong currents), needles 6 in. long	1	17	6	,,	2	10	0
3 large wire models of open coils. Iron wire painted white, 3 ft. long, viz.:	0	7	6	,,	0	12	0
(*a.*) right-handed							
(*b.*) left-handed							
(*c.*) conical							
1 magnetic needle, horizontally supported (agate), 6 in. long	0	10	6	,,	1	10	0
Large hoop coil of covered copper wire, 18 in. diam.	0	18	0	,,	2	0	0
2 bobbins of copper wire, with ebonite tube core (for electro-magnet), 2 in. internal diam., 8 in. long	3	0	0	,,	10	10	0
1 horse-shoe core for ditto							
2 soft iron cylindrical cores for ditto	0	10	0	,,	2	10	0
1 suspended helix, with terminals in mercury cups (thin copper wire), 9 in. long	0	10	0	,,	0	12	0
2 floating helices, one cylindrical, the other hoop, with zinc and copper terminals (to float in acid).	0	12	0	,,	1	0	0
1 Volta's pile	0	15	0	,,	1	10	0
1 Wollaston's cell	0	5	0	,,	0	15	0
5-cell Bunsen's battery	1	15	0	,,	2	12	6
14-cell Daniell's battery	3	10	0	,,	6	10	0
60-cell Grove's battery . . (A)	25	10	0	,,	30	0	0
1 Smee's cell	0	5	0	,,	0	10	0
1 Grove's gas cell for gas battery	1	0	0	,,	1	5	0
6 thin silver plates for polarized battery, 6 in. × 3 in.	0	7	6	,,	1	7	0
1 tangent galvanometer hoop, 18 in. diam., *accurate*, with screws, shade, &c., complete	3	10	0	,,	6	6	0
4 platinum spatulæ, each to weigh ½ oz.	2	16	0	,,	3	0	0
1 rectangular glass cell, blown, 6 in. × 5 × 3	0	15	0			—	
1 pillar stand for hot platinum spiral	0	15	0			—	
Goodeve's modification of Wheatstone's bridge	3	3	0	,,	6	6	0
Resistance coils, 10 selected from 1,000 to 1	15	0	0			—	
Board with metal screws	1	0	0	,,	1	6	0



	£	s.	d.		£	s.	d.
1 accurate balance, in case, weigh to 50 grammes turn to ·0005 grammes	8	10	0	,,	19	0	0
Agate supports, release, to weigh 500 grammes turn to ·005 grammes	12	12	0	,,	14	10	0
4 sets of gramme weights from 500 grammes	3	3	0			—	
A Wheatstone's rheostat	3	3	0	,,	15	15	0
Faraday's balanced wire, to show attraction and repulsion of current	0	6	6	,,	0	10	0
2 flat coils for attraction and repulsion	0	12	0	,,	0	15	0
6 mercury cups, ebonite, 1 in. diam.	0	7	6	,,	0	18	0
1 glass cell for electrolysis of water and salt, 1 ft. × 6 in. × 2 in.	1	0	0			—	
4 cells, glass, for electrolysis of metallic solutions, to fit in lamp, with screw clamps for fine platinum wire	3	0	0	,,	5	0	0
1 Faraday's voltameter	4	15	0	,,	5	5	0
1 Guthrie's voltastat	2	0	0	,,	3	10	0
A small magneto-electric machine, with Siemens' armature	2	10	0	,,	2	12	6
1 dissected coil, 8 in. long	1	10	0	,,	2	10	0
1 Ruhmkoff's coil, with separated condenser	5	5	0	,,	25	0	0
Model of Morse's make break and relay	2	0	0	,,	4	0	0
Contact breaker and reverser in one	0	18	0	,,	2	10	0
Faraday's balanced wire	0	8	0	,,	0	12	0
Faraday's rotating frame	0	7	6	,,	4	0	0
Spark from Ruhmkoff's coil, revolving in vacuo around electro-magnet (reversible)	2	2	0	,,	4	10	0

	£	s.	d.		£	s.	d.
1 Barlow's wheel	0	8	6	to	0	12	0
Disk of copper, to revolve beneath needle. 9 in. diam., ⅛ in. thick	0	18	0	„	3	12	0
A slab of uranium glass	1	1	0	„	1	15	0
Goodeve's model to illustrate needle telegraph	0	15	0	„	1	10	0
Model of Wheatstone's relay	10	0	0			—	
Morse's telegraph	9	10	0	„	10	10	0
Electric alarum	1	0	0	„	1	10	0
Electric thermometer	0	7	6	„	1	10	0
2 bars (1.) Bismuth. (2.) Antimony. (Each 4 in. long.)	0	12	0			—	
1 thermopile	3	3	0	„	5	10	0

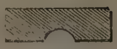
Materials, Frictional and Voltaic Electricity.

	£	s.	d.		£	s.	d.
book, gold leaf	0	1	6	„	0	2	6
book, Dutch metal	0	0	2	„	0	1	0
1 lb. tinfoil	0	1	6	„	0	3	0
1 piece of amber, ½ oz.	0	0	6	„	0	2	6
3 sticks, sulphur	0	0	6	„	0	6	0
1 cat's skin	0	2	0	„	0	6	0
1 fox's brush	0	2	6			—	
3 yards best black silk	1	1	0	„	1	16	0
3 lb. electrical amalgam	0	13	6	„	1	13	0
4 yards best white flannel (all wool)	0	10	0			—	
3 glass tubes, closed at one end, 2½ ft. long, 1¼ in. external, 1 in. internal diameter 1 Ditto ditto partly ground	0	7	[illegible]	„	0	15	0
3 yards gutta percha ribbon	0	2	6			—	
1 skein China silk	0	1	0	„	0	5	0
1 skein cocoon silk	0	1	0	„	0	3	6
1 skein silk braid without cotton	0	2	0	„	0	5	0
50 pith balls	0	3	0	„	0	4	6
2 square feet vulcanized india-rubber, sheet, ⅛ in. thick	0	7	6			—	
4 lbs. shellac	0	8	0	„	0	12	0
2 square feet sheet ebonite, $\frac{1}{16}$ in.	0	7	0			—	
6 yards brass chain	0	2	0	„	0	4	0
Bars of:— Magnesium Zinc Tin Iron Lead Silver Copper Platinum Bismuth Antimony } 6 in. long, ¼ in. diam.	6	10	0			—	
12 lbs. iron filings	0	5	0	„	0	10	0
20 yards copper covered wire, No. 12	0	5	0	„	0	7	0
20 ditto ditto No. 16	0	3	0	„	0	3	6
6 plates of tin plate	0	2	0	„	0	3	0
1 square foot thin platinum foil	3	0	0			—	
12 feet hardened crinoline steel	0	9	0			—	
4 copper balls, with eyes, on stands, 3 in. diam.	2	0	0			—	
4 iron balls, with eyes, on stands, 3 in. diam.	0	10	0			—	
6 cubes of nickel, ¼ in.	0	1	0			—	
1 lb. of bismuth	0	15	0	„	0	18	0

MAGNETISM.

Apparatus.

	£	s.	d.		£	s.	d.
4 soft iron bullets, from ½ in. to ⅛ in. diam.	0	10	0	„	0	18	0
1 bar of soft iron, same dimensions as bar magnets	0	1	6	„	0	5	0
1 small vertical test needle	0	10	0	„	0	15	0
1 wooden sphere, with copper coil, on stand (Barlow's), with binding screws to show earth's magnetism	3	15	0	„	4	0	0
Cylindrical bar of soft iron in glass tube, in copper coil, for magnetic expansion, 3 feet long	0	15	0	„	1	0	0
1 dipping needle	1	1	0	„	1	5	0
1 compass needle	0	2	6	„	0	15	0
Box of small magnets for consequent poles	0	7	6			—	
1 steel horse-shoe for magnetization and demagnetization	0	10	0	„	0	12	0
1 iron bar for earth's magnetism, 5 ft. long, perfectly soft	0	7	6	„	0	10	0
4 lode-stones	0	10	0	„	[illegible]	10	0
6 flat magnetic needles bored through centre, from 9 in. to 1 in. long	0	9	0	„	0	15	0
6 needle stands for magnetic needles, from 1 in. to 6 in. in height	0	15	0			—	
12 agate caps	0	14	0	to	3	0	0



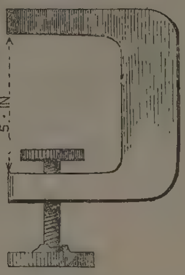
Size.

	£	s.	d.		£	s.	d.
2 pairs of bar magnets bored through centre, 1 ft. in length	1	1	0	„	1	10	0
1 large Permant magnet, 9 in. high, on wooden stand	0	7	6	„	3	0	0

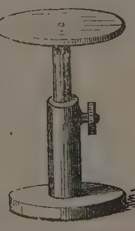
APPARATUS AND MATERIALS, GENERAL.

	£	s.	d.		£	s.	d.
1 iron pestle and mortar	0	2	6	„	0	10	0
12 papers of needles, from darning to finest	0	2	0	„	0	3	6
20 knitting needles	0	1	6	„	0	2	0
6 square feet of iron wire gauze, from very coarse to finest	0	6	0	„	1	0	0
20 sheets stout white card board, 2 ft. × 2 ft.	0	12	0	„	0	14	0
3 photographic dishes, 1 ft. × 9 in. porcelain	0	7	6			—	
2 test tube stands for 24 tubes	0	4	0	„	0	10	0
1 gross test tubes, assorted	0	10	0	„	0	14	0
24 cylindrical wooden blocks:—							

	£	s.	d.		£	s.	d.
12, ½ in. high 6, 2 in. high 4, 3 in. high 2, 6 in. high } 9 in. diameter	0	18	0	„	2	5	0
6 brass table clamps	1	4	0	„	2	10	0



	£	s.	d.		£	s.	d.
12 table stands	2	8	0	„	4	10	0



to stand 18 in. high

	£	s.	d.		£	s.	d.
6 universal wooden holders	1	16	0	„	3	15	0
6 iron retort stands, with 4 rings each (heavy footed)	2	2	0	„	2	10	0
1 gross circular and square glass plates, average 5 in. diameter, and diagonal	0	12	0			—	
100 lbs. mercury in iron bottle	17	0	0	„	20	10	0
1 lb. sulphide of calcium	0	3	6	„	0	4	0
1 lb. sulphide of strontium	0	10	6	„	0	15	0
1 lb. sulphide of barium. In sealed tubes	0	5	6	„	0	6	0
20 lbs. fluor spar	0	5	0	„	0	10	0
2 oz. platinum wire of selected thicknesses	2	16	0	„	3	0	0
4 ozs. precipitated silica	0	4	6	„	0	5	0
½ lb. magnesia "usta"	0	1	0		0	2	6
20 lbs. quick lime	0	1	0			—	
5 lbs. oxide of mercury	1	15	0	„	2	10	0
2 lbs. ammonia alum	0	2	6			—	
2 ozs. solution sulphate of indigo	0	0	6	„	0	1	0
1 lb. tetrachloride of carbon	0	10	6	„	0	12	0
10 lbs. chlorate of potash	1	5	0	„	1	6	0
1 lb. gum arabic	0	2	0	„	0	2	6
20 lbs. oxide of manganese	0	4	6	„	0	12	6
5 lbs. nitre	0	3	6			—	
2 lbs. cyanide of potassium	0	6	6	„	0	7	0
5 ozs. nitrate of silver	0	19	0	„	1	4	0
10 lbs. chloride of calcium (fused)	0	15	0	„	0	18	6
1 oz. litmus	0	0	4	„	0	0	6
2 lbs. acetate of lead	0	2	6			—	
1 lb. sulphate of iron	0	0	6			—	

	£	s.	d.		£	s.	d.
6 yards muslin, 3 kinds	0	10	0			—	
1 carboy of sulphuric acid	0	0	1½	per lb.			
1 carboy of nitric acid	0	0	7	,,			
1 carboy of hydrochloric acid	0	0	1½	,,			
1 pair bellows	0	7	0			—	
1 lb. iodine	1	16	0	to	2	6	6
10 lbs. bisulphide of mercury	2	14	0	,,	3	15	0
6 ozs. iodide of mercury	0	12	0	,,	0	16	0
5 lbs. chloride of ammonium	0	4	6	,,	0	5	0
20 lbs. sulphate of soda	0	4	6	,,	0	16	0
8 lbs. sulphate of copper	0	4	0	,,	0	5	0
1 lb. sulphuric ether	0	6	6	,,	0	8	0
10 lbs. paraffine (solid)	0	15	0	,,	0	18	6
1 gallon turpentine	0	4	0	,,	0	6	0
1 gallon olive oil	0	6	0	,,	0	9	0
4 bolt heads, 2 gallons	1	0	0			—	
12 ebonite penholders	0	3	0	,,	0	6	0
1 glazier's diamond	0	18	0	,,	1	5	0
1 gallon methylated spirit	0	4	6	,,	0	7	6
30 yards india rubber tubing, ½ in.	2	0	0	,,	3	10	0
30 yards ditto ditto ⅛ in.	1	2	0	,,	1	7	6
2 iron pans with wooden handles	0	7	6			—	

	£	s.	d.		£	s.	d.
½ lb. flowers of sulphur	0	0	3	,,	0	0	6
2 ozs. red lead	0	0	3	,,	0	0	6
1 lb. starch	0	1	0			—	
½ oz. iodide of potassium	0	1	6	,,	0	2	0
A box of wafers	0	0	6			—	
¼ lb. gunpowder	0	0	4	,,	0	1	0
6 square feet thin sheet glass	0	4	6	,,	0	5	0
6 ½-lb. round-bottomed flasks	0	2	0	,,	0	6	0
½ ream white blotting paper	0	7	6	,,	0	12	0
6 funnels, from 2 pints to ¼ pint	0	4	6	,,	0	7	6
24 silvered glass beads, from ⅔ in. to ⅒ in. diameter	0	2	0			—	
6 Bunsen burners, small size	0	9	0	,,	1	4	0
10 lbs. soft German glass tubing, ¾ in.	0	15	0			—	
5 lbs. ditto ditto ⅓ in.	0	7	6	,,	0	8	6
5 lbs. ditto ditto ⅛ in.	0	7	6	,,	0	10	0
6 wooden trays, 2½ ft. × 1½ ft.	1	16	0			—	
1 set cork borers	0	0	1	,,	0	12	0
1 cork knife	0	1	0	,,	0	2	0
1 bottle collodion	0	2	6	,,	0	6	6
12 dozen selected corks	0	3	6	,,	0	6	0
A box of carpenter's tools	1	0	0	,,	2	0	0

INORGANIC CHEMISTRY.

Elementary Stage.

1. *Bunsen Burner, with Rose.*—For burning a mixture of coal-gas and air, the latter being admitted through the small holes at foot. The rose is used for gently heating a glass or porcelain vessel, as in Exps. 55 & 91; without the rose, a long, narrow, intensely hot flame is produced, suitable for ignition, as in Exp. 1, but not for direct application to glass or porcelain vessels. From 2*s.* 1*d.* to 7*s.* 6*d.*

2. *A Dozen Test Tubes.*—(Exps. 2, 35, 36, 39, 45.)—For exposing various substances to a moderate degree of heat. 8*d.* to 2*s.* per doz.

3. *Three Test Glasses on Feet.*—(Exps. 7, 8, 23, 34, 47, 48, 65, 73, 74, 78, 80, 81, 82, 103, 109.)—For showing the effect of mixing various solutions. 6*d.* to 3*s.* each.

4. *Two Small Strong Cylinders,* 6 in. × ¾ in.—For showing the formation of hydrochloric acid (Exp. 6). One is filled with hydrogen, the other with chlorine, both being closed with glass disks; they are then placed mouth to mouth, chlorine uppermost, the discs withdrawn, the gases allowed to mix perfectly, and the jars separated, when the application of a flame to the mouth of each cylinder causes an explosion, with production of hydrochloric acid. 3*d.* to 2*s.* each.

5. *Two Cylinders on Feet,* 12 in. × 1 in.—(Exps. 2, 12, 15, 16, 17, 19, 24, 40, 52, 53, 54, 57, 58, 62, 67, 70, 77, 85, 89, 94, 95, 96, 99, 101, 102, 106.)—For demonstrating the properties of gases. 1*s.* to 2*s.* each.

6. *Two Cylinders on Feet,* 15 in. × 2 in.—(Exps. 21, 27, 49, 69.)—For similar purposes. 1*s.* 6*d.* to 5*s.* each.

7. *A Cylinder on Foot,* 30 in. × 3 in.—(Exps. 25, 69, 84.)—For demonstrating the solubility of certain gases in water. The cylinder must be filled with dry gas and closed with a stout glass plate, grasped firmly, and the mouth dipped into water, the plate being slid off so as to allow a very small jet of water to enter the cylinder as the absorption proceeds. 5*s.* to 32*s.*

8. *Two-necked Woulff's Bottle, fitted with Thistle Funnel and Delivery Tube.*—For the preparation of gases not requiring the application of heat, as hydrogen, carbonic anhydride, nitric oxide, and sulphuretted hydrogen. (Exps. 13, 34, 50, 54, 68, 92.) The tube of the funnel must dip into the liquid in the bottle. 1*s.* 9*d.* to 4*s.*

9. *Two-necked Woulff's Bottles fitted up as Wash-bottles for washing Gases.*—For freeing gases from traces of the acids used in their preparation, by passing them through water or alkaline solutions. The inlet tube should just dip beneath the surface of the liquid. By placing strong sulphuric acid instead of water in these bottles, any gas passed through will be freed from moisture. (Exps. 26, 34, 50, 54, 68, 92.) 1*s.* 4*d.* to 3*s.*

10. *Three-necked Woulff's Bottles fitted up as Wash-bottles, with Third Tube as Safety Tube.*—(Exps. 18, 22, 26, 41, 55, 61, 98, 100, 105.)—For similarly washing very soluble gases, as hydrochloric acid and ammonia. The inlet and safety tubes should just dip beneath the surface of the washing liquid. The safety tube permits of the entrance of air, in case of any running back of water through absorption of gas, and so restores the equilibrium of pressure. 1*s.* 9*d.* to 4*s.*

11. *Large Flasks fitted with Cork, Thistle Funnel, and Delivery Tube.*—For the preparation of gases from liquids by the aid of heat. Flame should not be allowed to come in contact with the glass, a piece of iron-wire gauze or a sand-bath being interposed between the flask and the source of heat. (Exps. 18, 22, 26, 41, 55, 56, 61, 98, 100, 105.) 1*s.* 3*d.* to 3*s.*

12. *Smaller Flasks,* fitted up as No. 11, and used for similar purposes. (Exps. 14, 107.) 10*d.* to 1*s.* 6*d.*

13. *Small Flask fitted with Cork and Delivery Tube.*—(Exps. 60, 72, 76, 104.)—For heating substances, generally solids, and collecting products of decomposition. Without the tube this may be used as a receiver to condense nitric acid, in Exp. 76. 7*d.* to 1*s.* 6*d.*

14. *Large Flasks with Wide Necks.*—For burning phosphorus in oxygen, &c. (Exps. 28, 66, 71.) 1*s.* to 4*s.*

15. *Three Florence Flasks with Corks and Delivery Tubes.*—(Exps. 26, 65, 79, 83, 86.)—For use when the naked flame must be applied to a glass vessel. Being cheap, the fracture of these flasks is of slight consequence. 4*d.* to 1*s.* each.

16. *Flask with Cork and Two Tubes, used for washing Gases.*—(Exps. 26, 41.)—For purposes similar to those described in No. 9. Specially, as in Exp. 26, for passing a gas through hot water, so as to mix it with steam. 1*s.* to 2*s.*

17. *Large Beaker.*—(Exps. 42, 43, 90, 108.)—For use when hot solutions are required in open vessels, or when substances are mixed which by their action evolve heat. To be heated upon gauze or a sand-bath. 10*d.* to 2*s.*

18. *Retorts, one large, one smaller.*—(Exps. 76, 90.)—For use in distillation, as of nitric acid. 9*d.* to 3*s.*

19. *Large Flask, 1–2 Gallons, with Cork and Five Tubes passing into it, one reaching just through the Cork, the remainder to the Centre of the Flask.*—To illustrate the manufacture of sulphuric acid; oxygen or air, nitric oxide, sulphurous anhydride, and steam being admitted through the longer tubes, and an aspirator attached to the shorter one, to maintain a constant current. (Exp. 107.) 2*s.* 6*d.* to 6*s.*

20. *Two-necked Bottle fitted as Wash-bottle, but with wide inlet tube.*—(Exp. 61.)—For decomposing ammonia by chlorine. A deposit of sal-ammoniac is formed, which would choke a narrow inlet tube. 1*s.* 9*d.* to 4*s.*

21. *Voltameter to decompose Water and collect the Gases separately.*—(Exps. 11, 20.)—May be used also to electrolyse aqueous hydrochloric acid and ammonia. The battery, No. 49, is employed for this purpose. 2*s.* to 60*s.*

22. *Bell-jar with Stop-cock, and Glass Vessel for Bell-jar to float in.*—(Exp. 30.)—To be filled with a mixture of two volumes of hydrogen and one of oxygen. The gas can be transferred by downward pressure of the jar and opening the stop-cock into a bladder or collodion balloon, which is then exploded by contact with flame. 7*s.* to 60*s.*

23. *Stoppered Cylinder on Foot.*—(Exp. 33.)—For the preparation of ozone, by leaving a piece of freshly cut phosphorus for 30 or 40 minutes in a shallow layer of water at the base of the cylinder. The phosphorus should rise above the water, so as to be partly in contact with the air enclosed in the cylinder. 2*s.* to 10*s.*

24. *Long Thistle Funnel Tube.*—(Exp. 40.)—For conveying sulphuric acid to the bottom of a glass of water, so as to procure the combustion of phosphorus in contact with potassic chlorate. Used also for pouring liquids into non-tubulated retorts without wetting the insides of the necks. 2*d.* to 1*s.* 9*d.*

25. *Glass Tube and Silk Rubber.*—(Exp. 4.)—For producing electricity. 1*s.* to 7*s.* 6*d.*

26. *Large Tubulated Bell-jar.*—(Exp. 59.)—The jar being closely stoppered is placed over a capsule, floating on water, containing ignited phosphorus. When the phosphorus ceases to burn, the jar is depressed, so as to equalise the level of the water within and without. The stopper being then removed, the residual gas can be tested and shown to be nitrogen. 2*s.* 2*d.* to 10*s.*

27. *Tubulated Aquarium.*—(Exp. 51.)—To be filled with carbonic anhydride through the tubulure at bottom, until the gas overflows. Soap bubbles filled with air will float when they are allowed to fall into the glass vessel. 4*s.* 6*d.* to 5*s.*

28. *Shallow Glass Dish.*—(Exp. 46.)—For exposing a large surface of lime-water to the air of the room wherein a lesson is being given, to prove the presence of carbonic anhydride therein. 1*s.* to 2*s.* 6*d.*

29. *Series of Two-necked Bottles.*—For passing SH through various solutions of metallic compounds to produce sulphides. (Exp. 97.) The bottles should contain aqueous solutions of arsenious anhydride, cupric sulphate, plumbic acetate, tartar emetic, manganous chloride, and zincic sulphate. 2*s.* 6*d.* to 10*s.*

30. *A Tube with Stopcock at Bend surrounded by Glass Vessel to contain Freezing Mixture.*—(Exp. 100.)—For the liquefaction of sulphurous anhydride by a mixture of ice and salt. 4*s.* to 12*s.*

31. *Combustion Tube containing Spongy Platinum.*—(Exp. 105.)—Through the heated tube is passed a mixture of two volumes of sulphurous anhydride and one volume of oxygen. They combine to form sulphuric anhydride, which produces dense white fumes when it issues from the tube into moist air. 1*s.* 6*d.* to 11*s.* 1*d.*

32. *Globe with Two Platinum Wires for passing a Stream of Electric Sparks through Air.*—(Exp. 63.)—Under the stimulus of the intense heat of the spark, the constituents of the air in the globe combine to form ruddy fumes of nitrous anhydride and nitric peroxide, which redden moist litmus paper. 1*s.* 6*d.* to 17*s.* 6*d.*

33. *Clock Glass.*—(Exp. 44.)—To contain an alcoholic solution of boric acid, which, on ignition, burns with a characteristic green-edged flame. 4*d.* to 1*s.*

34. *Tube for Heating Mercurial Oxide.*—To show its decomposition into mercury and oxygen. (Exps. 10, 26.)—The mercury condenses in the bend, the gas passing onwards to a pneumatic trough. 6*d.* to 1*s.*

35. *Jet from which to Burn Hydrogen.*—(Exps. 21, 31.)—To be attached by a flexible tube to a hydrogen apparatus (No. 8), and, the gas being lighted, lowered into a jar of chlorine or oxygen. 4*d.* to 1*s.*

36. *Gasholder.*—(Exps. 29, 105, 107.)—For storing gas for some time, or supplying it in considerable quantity when required for experiment. May be used also as an aspirator (Exp. 19). 16*s.* 6*d.* to 80*s.*

37. *Porcelain Capsule.*—(Exp. 59.)—For use with the bell-jar, No. 26, in the preparation of nitrogen from atmospheric air. 3*d.* to 1*s.*

38. *Platinum Foil and Wire.*—(Exp. 88.)—The foil serves to show the fixedness or volatility of substances when exposed to a red heat; the wire is used for preparing coloured beads with metallic oxides and fused borax. 1*s.* to 2*s.* 6*d.*

39. *Two Deflagrating Spoons.*—(Exps. 28, 66, 71.)—For showing the combustion of sulphur, phosphorus, sodium, &c., in oxygen and chlorine. 9*d.* to 2*s.*

40. *Pestle and Mortar.*—For pulverising various substances.—1*s.* to 5*s.* 9*d.*

41. *Broad Camel-hair Brush.*—(Exps. 37, 38.)—For brushing a solution of hydroxyl over discoloured white paint, so as to restore its original whiteness. 6*d.* to 1*s.* 6*d.*

42. *Iron Tripod Stands.*—For supporting flasks, &c. over lamps. 9*d.* to 5*s.*

43. *Two Retort Stands.*—For a similar purpose. 2*s.* to 16*s.* 6*d.*

44. *India-rubber Tubing, assorted.*—For making connections between the tubes of various pieces of apparatus, as in Exp. 54, where Nos. 8, 9, 45, and 10 are used. It may be cut into lengths of two or three inches for this purpose. 6*d.* to 2*s.* per yard.

45. *Clay Furnace for Burning Coke, with Iron Tube to pass through.*—(Exps. 26, 54, 86.)—For exposing a gas to a red heat. 10*s.* to 40*s.*

46. *Blowpipe Jet.*—(Exp. 29.)—Fitted to the gas-holder No. 36, a powerful blast of oxygen may be obtained, and used to show the burning of a bundle of steel wires, by allowing the jet of gas to blow through the flame of a spirit lamp. 1*s.* 6*d.* to 7*s.* 6*d.*

47. *Pneumatic Trough.*—1*s.* to 15*s.*

48. *Porcelain Tube to pass through Furnace.*—(Exp. 26.)—For use instead of the iron tube in No. 45 in cases where, as with chlorine, the use of iron is inadmissible. In heating a mixture of steam and chlorine the tube should be packed with broken porcelain or pieces of pumice, so as to afford as large a surface as possible. 4*d.* to 6*s.*

49. *Five-cell Grove's Battery.*—(Exps. 11, 20.)—For electrolysing water, hydrochloric acid, and ammonia. The full power is needed for this work. When used with an induction coil, the number of cells should be adapted to the size of the coil. 30*s.* to 90*s.*

50. *Induction Coil.*—(Exps. 63.)—For effecting the direct combination of nitrogen and oxygen by the intense heat of the electric spark. Also for decomposing ammonia gas and marsh gas by the same agency. A coil of the size exhibited will work well with five cells of the battery No. 49. 21*s.* to 25*l.*

APPARATUS for SPECIAL IMPORTANT ILLUSTRATIONS.

1. *Apparatus to decompose Steam by Stream of Electric Sparks.*—Consisting of a five-cell Grove's battery, a Ruhmkorff coil, a globe fitted with platinum wires for the passage of the spark, and a leading tube for gas, mounted upon a flask, in which to generate steam. The flask is half filled with water, which is made to boil, and the steam driven slowly through the globe, led into the pneumatic trough, and condensed. When the air is completely displaced from all parts of the interior, the platinum wires are connected with the coil, which is then set in action. A portion of the steam passing through the globe is thus decomposed, and the mixed oxygen and hydrogen gases can be collected over the pneumatic trough. 4*l.* 12*s.* to 13*l.*

2. *Apparatus for Gas Analysis.*—Intended to submit a mixture of gases to the successive action of absorbents, and so to determine its composition volumetrically. The *modus operandi*, divested of minor details, is simply this. The gas to be analysed is placed over mercury in the reservoir I, then drawn by the descent of a column of mercury into the measuring tube C, where its volume is determined. Being returned into the reservoir I, into which an absorbing agent is thrown, which deprives it of one constituent, the gas is brought back to the tube C and measured again, and this process is repeated until the composition of the mixture is ascertained. An equable temperature is maintained in the measuring tube C by the vessel H being filled with water, which can be agitated, if necessary. The pressure is regulated by the mercury cistern B, which is raised or lowered as may be necessary, and it is measured by the column of mercury in the tube A. 5*l.* 5*s.*

Instructions for using the Apparatus.

Let the gas to be analysed be common air, or the gas evolved by ebullition from natural waters, consisting usually of carbonic anhydride oxygen, and nitrogen. First, the gas is carefully transferred without loss to the jar I, and thence drawn by lowering the mercury reservoir and opening the stop-cocks into the tube C, where the apex of the mercury is brought to coincide with any graduation mark. Suppose the following observations to be made :—

Height of mercury in C - - -	250 mm.
Corresponding volume of gas as per calibration table - - - -	19·2 c.c.
Height of mercury in A - - -	130·4 mm.
Temperature of water in H - -	16·4° C.
Height of barometer - - -	763·1 mm

From these data the pressure upon the gas is calculated as follows :—

Height of barometer - - -		763·1 mm.
Deduct height of mercury col. in A from height in C, viz., 250—130·4 - - - -	119·6	
Plus tension of aqueous vapour (the interior of C being moist) at 16·4° C. - - -	13·9	133·5
Pressure on dry gas - - -		629·6

Hence we have 19·2c.c. of dry gas at 16·4° C. and 629·6 mm. pressure.

Absorption of Carbonic Anhydride.—This is effected by passing up into the jar I, by means of a small pipette, two or three drops of a concentrated solution of caustic potash. The gas is driven from the measuring tube C into contact with the potash solution by raising the mercury reservoir and opening the stop-cocks. A few minutes' exposure secures the absorption of the carboniic anhydride, and the residual gas, a mixture of oxygen and nitrogen, is drawn back into C and measured as before.

Absorption of Oxygen.—A few drops of a concentrated solution of pyrogallic acid are added to the solution of caustic potash in the jar I, and the gas driven from C as beofre. The alkaline potassic pyrogallate immediately absorbs oxygen, becoming of a deep blood-red colour. By careful manipulation, the jar I may be slightly agitated, so as to promote the absorption, which is known to be complete when the dark-coloured liquid thus thrown upon the sides of the glass runs off again without leaving a dark blood-red stain.

The remaining operation is to determine in C the volume of the residual nitrogen, and the analysis is finished.

Three uncorrected gaseous volumes are thus obtained, viz.:—

A = volume of three mixed gases;
B = volume of mixed oxygen and nitrogen;
C = volume of nitrogen.

By the formula given below these volumes may be reduced to 0° C. and 760 mm. pressure, and then from the corrected volumes A′, B′ and C′, so obtained, the quantity of each gas in the mixture may be deduced.

A′ — B′ = volume of carbonic anhydride.
B′ — C′ = volume of oxygen.
C′ = volume of nitrogen.

The centesimal composition of the mixture is then very easily calculated.

The following formula may be used to bring the observed volumes to standard temperature and pressure:—

$$\overline{(1+\cdot 003665\,t)\,760.}$$

V = observed volume of gas in cubic centimetres.
P = pressure upon the dry gas.
t = temperature at the time the volume was measured.

For further details, see *Chemical Society's Journal*, vol. xxi. p. 109.

3. *Apparatus for the Determination of Vapour Densities by Gay-Lussac's Process, and by Dumas' Process.*

Gay Lussac's Process.—The principle of this method is to convert a known weight of a substance, confined over mercury, into vapour, the volume of which being measured at known temperature and pressure, can be readily reduced by calculation to that at standard temperature and pressure. 1*l.* 10*s.* to 1*l.* 10*s.* 5*d.*

Dumas' Process is the reverse of the preceding. A known volume of a vapour is first measured, and its weight then ascertained; from these data the vapour-density under standard conditions is calculated.

Further details may be found in Miller's *Chemical Physics.*

4. *Apparatus for showing that Hydrogen and Chlorine do not contract when they unite to form Hydrochloric Acid.*—This consists of a glass tube having a stop-cock at each end, and filled with a mixture of hydrogen and chlorine in equal volumes. By opening one end of this tube under mercury it is proved to be completely full of gas. Then, either by the light of burning magnesium wire, or by an electric spark passed between two platinum wires fused into the tube, the gases are caused to combine. On opening the tube a second time under mercury, after cooling, the volume of the contained gas is shown to be the same as before combination, and solution of the hydrochloric acid gas in blue litmus-water proves that no hydrogen or chlorine is left. (See Hofmann's *Modern Chemistry*, Lecture iii.) 5*s.* 5*d.* to 10*s.* 6*d.*

5. *Apparatus for the Decomposition of Ammonia by Electric Sparks, and for the subsequent Combustion of the liberated Hydrogen by Cupric Oxide.*—A certain volume of dry ammonia gas is confined in the closed limb of the tube, and the height of the mercury therein, after equalisation of pressure in both limbs, carefully marked. Electric sparks are then passed for some minutes between the two platinum wires; the high temperature of the spark decomposes the gas, which expands to exactly double its original volume. Then the voltaic current from five or six cells of a Grove's battery is passed through the spiral of platinum wire, so as to ignite some included pieces of cupric oxide. The hydrogen is thus gradually removed, and nitrogen alone is left to the amount of one half in bulk of the ammonia originally taken. Hence it is proved that two volumes of ammonia gas are composed of one volume of nitrogen and three volumes of hydrogen. In noting the volumes, the level of the mercury must be equalised in both limbs of the tube. 7*s.* 6*d.* to 20*s.*

6. *Apparatus for the Decomposition of Marsh-gas.*—A convenient volume of marsh-gas is introduced into the closed end of the tube, and, after equalising the pressure, its bulk is marked. It is then decomposed by sparks from an induction coil, with an occasional reversal of the current. Carbon is deposited upon the platinum terminals, and the gas, after decomposition, occupies double its original volume. This product of decomposition can be shown to be hydrogen by igniting it at the jet, when it burns with a flame, which is, however, more or less luminous, on account of the formation of a small quantity of acetylene during the process of decomposition. 6*s.* 6*d.* to 16*s.* 6*d.*

7. *Apparatus for showing that when Carbon or Sulphur burns in Oxygen no Alteration of Volume takes place.*—This consists of a U-tube with a bulb blown in one limb, capable of being closed with a stopper, through which are passed copper wires sustaining a deflagrating ladle of bone-earth to contain charcoal or sulphur, which may be ignited by the transmission of a galvanic current through a fine platinum wire. The bulb being filled with dry oxygen, and the level of the mercury being marked, ignition of the charcoal or sulphur is effected, and on the cooling of the gas it will be observed that no change of volume has occurred on conversion of oxygen into carbonic or sulphurous anhydride. 10*s.* to 25*s.*

8. *Ozone Apparatus.* — This is intended to ozonise oxygen by induction. It consists of a glass tube coated outside with tinfoil; within this is placed a narrower tube lined with tinfoil or silvered inside. The two metallic coatings are connected with the two ends of the secondary wire of an induction coil, and while a "silent discharge" is made to pass between the two tubes, a current of dry oxygen is slowly driven through from a gasholder. A portion of the oxygen is converted into ozone, which can be detected by means of iodised starch paper at the exit end of the tube. It is important that the oxygen should be perfectly dry, otherwise the quantity of ozone formed will be very small. 5*s.* to 25*s.*

9. *Galvanometer.*—The action of this instrument depends upon the fact that a magnetic needle, freely suspended at its centre, and placed in the neighbourhood of a wire or other conductor along which a current of electricity is passing, tends to place itself at right angles to the line of the current. In practice two parallel needles are mounted the one above the other upon the same pivot, with their poles in contrary directions, so that the action of the earth's magnetism upon them shall be reduced to a minimum. The lower needle is then adjusted within a coil of silk-covered copper wire, and the upper one above a cardboard disk on which is marked an arc graduated into degrees. On a current of electricity traversing the coil of wire, even though it be the feeble current produced by a slight variation of temperature on the face of a thermopile, the motion of the upper needle at once indicates the existence, and to some extent the force of the current. 6*s.* to 5*l.* 5*s.*

10. *Thermopile.* — An instrument for producing feeble currents of electricity by warming at their points of junction bars of bismuth and antimony soldered together. A number of couples of this kind are packed in a brass case, so that half the joints may be on one side and half on the other. The slightest variation of temperature between the two sets of joints is enough to excite a current of electricity, which may, by means of wires attached to the terminal bars, be conducted to a galvanometer, and measured. The heat given off by the human body at a distance of 10 yards is sufficient to affect a delicate instrument. 10*s.* 6*d.* to 5*l.* 10*s.*

11. *Daniell's Hygrometer.*—This is an instrument for determining the "dew-point," or the temperature at which the aqueous vapour contained in the air begins to be condensed. It consists of a glass syphon connecting two bulbs. One of the bulbs is blackened, and contains ether, into which dips a small thermometer for the determination of the temperature of the liquid. The instrument is mounted on a stand bearing another thermometer to take the temperature of the surrounding air. The empty bulb is covered with muslin tied tightly round it. To use the hygrometer, a little ether is poured upon the muslin, and the cold produced by its rapid evaporation condenses the ether vapour inside the empty bulb as fast as it is formed in the blackened bulb. By this action the temperature in the blackened bulb is lowered. As soon as the dew-point is reached, aqueous vapour from the air condenses as dew on the black bulb, and at that instant the readings of the two thermometers must be observed. 12*s.* to 2*l.* 12*s.* 6*d.*

12. *Eudiometer to estimate Oxygen in Air.*—This instrument is first filled with water. The air to be examined is then introduced, and the level of the water adjusted to the zero of the scale marked on the tube. A few drops of water being now removed from the open end of the eudiometer by a tube, their place is supplied by an equal quantity of solution of potassic pyrogallate, or, what is the same thing, solutions of caustic potash and pyrogallic acid are separately used to refill the open end. The instrument is now closed with the thumb and violently shaken to promote absorption, and then opened under water so that the liquid may rise and its level be ascertained. All measurements must be taken after the eudiometer has been immersed in a glass cylinder containing water, so as to counteract the expansion caused by the warmth of the hand, and while the water is standing at the same level both within and without the tube. 6*s.* to 16*s.* 6*d.*

13. *Diffusion Tube.*—This is a tube closed at one end by a porous plug of plaster of Paris, and open at the other. In using it the plug must on no account be wetted. Hydrogen is the gas usually employed in diffusion experiments, owing to its greater rapidity of motion. The tube may be filled with hydrogen by displacement, first closing the top of the tube by a cork so that no gas may escape through the plug. On then placing the open end of the tube in coloured water, the rise of the liquid on removing the cork shows that the hydrogen escapes through the porous plug more rapidly than the air enters the tube in the opposite direction. Or the open end of the tube may be dipped into water, and a cylinder of hydrogen lowered over the plugged end. The diffusion of hydrogen into the tube is so much in excess of the diffusion of air out of it, that bubbles are forced through the water as if they were violently blown out of the tube. 1*s.* to 2*s.*

14. *Oxyhydrogen Blowpipe and Gas Bags.*—The use of these is sufficiently understood. The chief precaution to be observed is, that the hydrogen must always be ignited before the oxygen is turned on, and an excess of oxygen is to be carefully avoided. Twice as much hydrogen as oxygen (by measure) should be burned. 16*s.* 6*d.* to 8*l.* 10*s.*

15. *Cavendish's Eudiometer.*—This is used for demonstrating the production of water by the explosion of a mixture of oxygen and hydrogen. It is filled by first exhausting it of air at the air-pump, turning off the stop-cock, and then connecting it with a receiver standing over water and containing a mixture of hydrogen and oxygen in the proportions requisite to form water. The stop-cock being first opened and then closed, the mixture is exploded by the electric spark. After the explosion, the interior will be perceptibly moistened by minute drops of water. 35*s.* to 50*s.*

16. *Apparatus to prepare Acetylene from Hydrogen and Carbon.*—This is a globe, designed to contain hydrogen, with two carbon electrodes nearly meeting in the centre. A Grove's battery of 20 cells is to be connected with these electrodes, which must first be pushed together and afterwards separated so as to produce the voltaic arc. Under the influence of the heat thus generated, combination ensues between the carbon and hydrogen, and acetylene in small quantity is formed. 5*s.* to 15*s.*

17. *Twenty Cells of Grove's Battery.*—To be used with the preceding. 5*l.* to 16*l.* 16*s.*

18. *Apparatus for preparing Acetylene from Coal-gas by a Stream of Electric Sparks.*—This much resembles No. 16, a current of coal-gas being substituted for one of hydrogen, and the sparks obtained from the coil No. 1. 3*s.* to 12*s.*

19. *Model Apparatus for Coal-gas.*—Intended to illustrate the manufacture of coal-gas. The copper retort is to be charged with coal and heated to redness in a charcoal furnace. The Woulff's bottle is intended to arrest tarry matter; the gas is then conducted through slaked lime or ferric hydrate to remove sulphuretted hydrogen, and is afterwards collected in jars or in a gasholder, from which it may be burnt at a jet. Care must be taken that all the air is expelled from the apparatus before the gas is collected. 15*s.* to 2*l.* 2*s.*

20. *Apparatus for exposing equal Volumes of Hydrogen and Marsh-gas to various Temperatures and Pressures.*—Equal volumes of two gases are placed in the two limbs of the U-shaped tube. The pressure may be increased by addition of mercury in the open tube, or diminished by running off mercury from the pinchcock at the bend. A glass cylinder surrounding the U-tube containing the gases forms a steam jacket, and affords the means of rapidly raising the temperature of the enclosed gases to 100° C. 14*s.* to 35*s.*

III.—SKETCH OF EXPERIMENTS IN PHYSICS AND IN INORGANIC CHEMISTRY.

See Memorandum on Science Programmes (page 62).

SKETCH OF EXPERIMENTS IN SOUND, HEAT, LIGHT, ELECTRICITY, and MAGNETISM. By Professors FREDK. GUTHRIE and WM. GOODEVE.

SKETCH OF EXPERIMENTS.

SOUND.

roduction sound.

A body in a state of vibration produces sound.

A glass goblet set in vibration in contact with pith balls.

A tuning fork set in vibration in contact with pith balls.

A large tuning fork struck and waved exhibits its vibrations.

n elastic ıedium is ecessary.

Alarum or musical box under the receiver of the air pump.

The end of a long wooden rod scratched by a pin.

One prong of a tuning fork is armed with a cork cone, which is plunged in water contained in a tube, one end of which is fastened to a sounding board.

All bodies are compressible.

ropagation f sound.

Bending of solids. Elasticity of air in syringe. Boyle's Law.

Propagation of force through a row of solitaire balls.

A tin funnel covered with a membrane is inserted into a tube filled with smoke, and struck.

Baden Powell's apparatus for transverse vibrations.

Nature of ound wave r undula- ion.

A thin vulcanized india-rubber tube 30 feet long, stretched (best vertically), shows transverse pulse and its reflexion, also the simultaneous existence of several pulses.

A thin tube as above, loaded with sand, and marked with tape, shows the passage of longitudinal vibrations, and their reflexion.

The same experiments with increased tension.

Baden Powell's apparatus employed to show that separate particles are in different phases.

Reflexion of sound.

Speaking tubes.

Ticking of watch heard through a long tube.

The same assisted by reflector behind the watch.

Refraction of sound.

Refraction of sound through a collodion balloon filled with carbonic acid.

N.B.—*The reflexion and refraction of sound may be made manifest by a sensitive flame.*

Imperfect elasticity and mechanical dispersion.

A hand bell ceases to be sonorous when heated over a Bunsen burner.

A glass goblet or funnel ceases to be sonorous when it contains an effervescing liquid.

Notes.

Dotted line formed on slate by pencil when a note is produced.

The same with brass tubing scraped with a knife.

Trevelyan's rocker.

Electric syren.

Toothed wheels on whirling table with card.

Perforated disk of cardboard on whirling table produces notes when air is blown upon the holes.

Syren.

Preliminary experiments to determine pitch of fork and organ pipe by coincidence with note of syren (without beats).

Rate of sound in air.

A whistle connected with an inflated india-rubber bladder is fastened to the whirling table. The note is graver during approach than during recession.

Transverse vibrations of elastic rod.

Vary length of very long rod swinging transversely in vice, and obtain law of vibration according to length.

Wheatstone's kaleidophone and figures (may be reflected and focussed on screen).

Effect of loading the rod.

A.—Lissajou's figures.

1 : 1, 1 : 2, 2 : 3, 3 : 4, &c.

Graphic analysis of vibrations exhibited by moving lamp-blackened surfaces across points fastened to selected forks.

Tranverse vibrations of strings.

Vary length of stretched wire
„ tension „ „
„ thickness „ „
„ material „ „
and deduce law of vibration.

Examine actual motion of a vibrating string by means of a bright bead fastened to it.

Nodes.

Nodes on long elastic rod held in the hand.

Nodes in struck bar vibrating transversely.

Musical glasses and sonorous bars.

Harmonics on tuning fork when the bow is drawn near the root, exhibited by strewn sand.

Chladni's figures on round and square plates, exhibited by sand and lycopodium.

Nodes on bell, exhibited by suspended pith balls and water in inverted bell-glass.

Multiple nodes in stretched indian-rubber tubing, one end being held in the hand.

Nodes formed in elastic ring on compressing and extending opposite sides.

Silk cord stretched across the mouth of a bell jar or bell exhibits nodes.

Silk cord stretched between vibrating forks shows nodes.

A.—Large fork (not sonorous) worked by electric "make and break," and fastened to a stretched silk cord, developes nodes.

Production of nodes by damping various points of a stretched steel wire. Test for nodes by riders.

Further inquiry into wave motion.

Experiments with spiral steel wire stretched spring, such as :—

(1.) Vibration when upper end is fastened and lower end is loaded. Compare with elastic rod fastened at one end.

(2.) Fasten at both ends and vibrate longitudinally and transversely.

(3.) Fasten as (2). Damp the centre and obtain the same nodes for transverse and longitudinal vibrations.

(4.) Increase number of nodes.

Longitudinal vibrations in a brass bar clamped in its centre exhibited upon a suspended ivory ball touching its end.

Longitudinal vibrations in a bar of wood.

Longitudinal vibrations in a rod of glass, exhibited by the creeping of a paper ring.

Compound longitudinal nodes on a strip of glass or metal.

Longitudinal vibration of a column of air, (*a*) closed tubes.

Air nodes in wide glass tube with moveable piston set up by longitudinal vibrations of an inserted brass bar (lycopodium).

Compare above with single resonant cylinder.

Resonance of closed cylindrical tubes with selected forks.

Closed tubes of lengths 1, 3, 5, &c., resound to the same fork, say C.

Closed tubes of lengths 2, 6, 10, &c., resound to lower octave of C.

(*b*) open tubes.

Open tube of length l vibrates to fork C.
„ „ $2\,l$ „ „ C and C′.
„ „ $3\,l$ „ „ C not C′.
„ „ $4\,l$ „ „ C and C′, &c., &c.

N.B.—*For closed tubes, glass cylinders tuned with water may be used. Numerous telescopic tubes of cardboard both closed and open should be constructed.*

Compare notes of open and closed tubes of equal length.

Examine nodes and segments in an organ pipe with a paper tray.

A.—Examine nodes in organ pipe by extinguishing gas jets in side chamber for fundamental note and octave.

Selection of vibrations by resonant column.

Cardboard disks are loaded and hung up by double wires of various lengths. Another card giving rythmical puffs of air sets one or other of the hung cards in oscillation.

A jet of hydrogen, when lighted beneath a glass tube, gives a resonant pop.

A rustling flame is converted into a sonorous one by a selected resonant tube.

Examine noise of embouchure with and without organ pipe.

Blow across open end of closed tube or jar with contracted neck or phial.

Sonorous goblet with resonant tube.

Metal bell with resonant box, closed and open.

Series of forks with resonant cylinders.

Use of sounding boxes with forks.

Alteration of law of resonance by spreading cavities.

Human voice reed pipes and other wind instruments.

Vowel spheres and forks.

Jews' harp.

India-rubber model of larynx.

Reed, with and without pipe.

Trumpet stop-pipe.

Trumpet.

Willis's "mama tube."

Compare closed pipe with a longitudinally vibrating spring with one end fixed.

Rate of travel of sound.

Length of closed pipe is one quarter of the wave length. Know or determine the number of vibrations of a fork resounding to a closed jar. Measure depth of jar, and so deduce the velocity of sound in air.

Make the same determination by means of an open tube; the length of an open tube being one half the wave length.

Show how the closed tube must be altered in length when filled with hydrogen or carbonic acid in order to resound to a given fork.

Bars of brass, glass, and wood of equal length, when in longitudinal vibration, require resonant air columns of different lengths: hence deduce sound rate in these solids.

Compare notes by transverse and longitudinal vibrations in brass and iron wires.

Communication of vibrations.

Sympathetic vibrations of forks in air.

Sympathy of tuned strings on monochord exhibited by riders on segments and nodes.

Sand or drum with organ pipe.

A bar held vertically is fastened to two blackened brass circular disks, upon which sand is strewn; the bar is rubbed with resined leather. The arrangement of the sand exhibits the transformation of longitudinal into transverse vibrations.

The above apparatus is held above a drum strewn with sand.

The sounding board is attached to a stretched string or fork.

The musical box is placed in the double felt case. A wooden rod with sounding board is introduced.

Sympathetic vibrations in a piano, violin, &c.

Interference beats.

Concord of forks.

Beats of forks on boxes and above a resonant cylinder.

Loading of forks.

Beats with organ pipes.

Beats between organ pipe and syren.

Beats between tuning fork and syren.

Determination of the number per second of the vibrations of several tuning forks by means of the elimination of beats.

A.—Beats by double syren.

Dissonant forks.

Lissajou's forks, parallel and vertical, to show interference by sinuosities on screen by consonant, harmonic, and dissonant forks.

Turn fork over resonant jar to detect lines of extinction at corners.

Interference in organ pipes illustrated by membranes, gas jets, and vibrating mirror.

Singing and sensitive flames.

Various sensitive flames affected by different vowels, and by hissing, rustling, &c.

Analyze singing flame in tube by means of a mirror.

Set up vibration in flame by an organ pipe or tuning fork.

Sympathy between two pipes when tuned by a moveable casing.

Approach caused by vibration.

Balanced card disk attracted by tuning fork.

Cotton wool attracted by tuning fork.

Balance card attracted by disks on rod in longitudinal vibration.

Hydrogen in collodion balloon repelled by tuning fork.

HEAT.

Simple experiments in expansion of solids, liquids, and gases.

Lengthen a stretched platinum wire by heating it by a galvanic current.

Fergusson's pyrometer, used with various metals through a fixed range.

Water, alcohol, mercury, oil, &c., completely filling equal flasks (2 oz.), provided with narrow tubes, are heated.

Air in a flask is expanded by heat, and a portion is expelled through a tube and collected over water.

A wide-mouthed balloon is held over a gas flame till it rises.

An air-tight, somewhat shrivelled bladder, becomes tense on heating.

The air thermometer and differential air thermometer constructed and explained.

Inequality and equality of expansion.

A compound band of copper and iron rivetted shows by its curvature when heated the superior expansion of copper.

A.—Complete galvanic circuit by the expansion of brass before the same is effected by iron.

Compound metal ribbons, as of silver and platinum, curl when heated.

Equal flasks of water, alcohol, oil, mercury, &c., full and furnished with narrow tubes, are equally heated. The liquids are found to expand unequally.

Equal flasks of air, nitrogen, oxygen, hydrogen, carbonic acid, &c., are equally heated by hot water, and the volumes of the gases expelled through narrow tubes and collected over mercury are the same.

Force of expansion and contraction.

Break cast-iron pin by the contraction of a cooling rod of iron.

Rupert's drops.

Break flasks of water quite full by expansion.

Thermometers.

Make thermometers (alcohol and mercury) and determine fixed points.

Daniells' pyrometer.

A.—Make and use a model of Siemens' pyrometer.

Maximum density of water.

Bring a cylinder of ice-cold water into a warm room, and test the temperature above and below.

Allow a full flask of ice-cold water with a narrow tube and inserted thermometer to become warm.

Conduction. Solids.

Wooden balls are stuck with soft wax at equal intervals along two bars of iron and copper placed end to end, heated at the place of contact. The superior conductivity of the copper causes the balls on it to fall off soonest.

Equally long cylinders of ivory, glass, clay, and various woods and metals are placed on flat top of air thermometer, and receive heat from above.

The same arrangement, substituting thermo-pile for air thermometer.

Apparent passage of cold by the above arrangements.

Liquids.

Boil water at top of test-tube held in the hand.

Boil water in test-tube over loaded ice.

Surround bulb of air thermometer with a cup containing water whose level is above the bulb, and pour hot water on the cold.

Examine conductivity of mercury, water, oil, oil of turpentine, tetrachloride of carbon, &c., by Guthrie's liquid conductivity cones.

Gases.

The hand, covered with asbestos, supports a red-hot ball.

Quenching of red-hot spiral of platinum by hydrogen.

Illustrations of conduction.

Put out flame of candle by thick copper coil of wire.

Burn gas above wire gauze.

Davy's lamp.

Test sensation of cold on plunging the hand into various liquids of the same temperature, as mercury, water, oil, &c.

Compound cylinder of brass and wood with serpentine division to scorch paper.

Melt a spherical leaden bullet in paper envelope.

Convection.

Bran or shreds of paper in round-bottomed flask heated over gas flame, show convection currents.

Streaks of water produced by descending currents of cold water from ice.

Streaks of ascending currents in water from heated platinum spiral (heated by galvanic current).

Same in flask of water when near boiling.

Show by two flasks and connecting tubing hot water circulation.

Ventilation exhibited by candle burning in a bell jar carrying a chimney divided by a diaphragm. The air current tested by smoke.

Heat platinum wire by current and show the ascending air on screen (fore-shorten).

Project on screen the hot currents from a candle and gas jet.

Project on screen the currents from a hot poker, &c.

Capacity for heat.

Compare the capacities of three glass cylinders of different diameters for water. Show how the withdrawal or addition of equal quantities of water affects the level.

Cylindrical slabs of metals of equal weight heated to the same temperature, melt different quantities of ice or wax. (Iron, zinc, lead, copper, bismuth, &c.)

Balls of the above metals of equal size heated in oil bath to 130° C. penetrate a cake of wax to different degree.

A ball or cube of copper heated to different degrees heats a given weight of cold water. (Siemens' copper cube pyrometer.)

Unit of heat.

Burn gunpowder mixed with sand in a copper vessel under water, and show that nearly the same amount of heat is absorbed in heating two weights of water one degree as in heating one weight two degrees.

Specific heat.

Equal weights of various hot metals are plunged into cold water of given weight, and the specific heats of the metals deduced.

Known weights of various hot metals are treated as above.

Known weights of cold metals are plunged into known weights of hot water to obtain confirmatory results.

Model of calorimeter for solids.

Mix 1 lb. of ice cold mercury with 1 lb. of water at 100° C.

Mix 1 lb. of ice cold water with 1 lb. of mercury at 100° C.

Perform the same experiments substituting oil of turpentine for mercury.

Vary the quantities, temperature, and nature of the substances, and deduce their specific heats.

Weigh a penny and a half-crown, boil them in water, place them in a cavity of ice covered with an ice slab, and weigh by means of blotting paper the quantities of ice they melt, and so deduce their specific heats.

Latent heat.

Determine the latent heat of water by pouring a pound of boiling water on a pound of dry powdered ice, and determining the temperature of the mixture.

Vary the temperature of the water and the quantity of the ice and water.

Weigh a cake of wax or paraffin just beginning to melt in hot water, melt a part of it by a known weight of boiling water, and determine its latent heat from the resulting temperature.

Pass low pressure steam into a known weight of ice cold water till the latter is at 100°; from the increase in weight of the water, deduce the latent heat of the steam.

Substitute boiling oil of turpentine for boiling water in the above, and deduce latent heat of vapour of oil of turpentine.

Vary the quantity, temperature, and nature both of the condensing substances and the vapours to determine the latent heats of the latter.

Relation of heat to change of state.

Surround bulbs of differential air-thermometer with cups of water, and dissolve various salts in one cup.

A.—Place shallow platinum crucible lid with water on thermo-pile, and dissolve various salts in the water. Show thermo current by galvanometer.

Water, alcohol, ether, &c., placed on bulb of air thermometer or differential air-thermometer absorb heat by their evaporation.

Cold produced by effervescence of mixed liquids.

Gases liquifying evolve heat, *e.g.*, ammonia and hydrochloric acid in water.

Liquids solidifying evolve heat, *e.g.*, a super-saturated solution of sulphate of soda poured upon the bulb of an air thermometer.

The same upon a protected thermo-pile.

Slake lime and hydrate anhydrous sulphate of copper, and so evolve heat by solidifying water.

Fuse various solids by heating them.
Solidify „ liquids „ cooling „
Vapourize „ liquids „ heating „
Condense „ vapours „ cooling „

A.—Various experiments with solid carbonic acid, *e.g.*, mix with ether, freeze mercury, therewith freeze water, freeze sulphurous acid, &c.

Illustrations of thermal effect of change of state.

Freezing mixtures.

Ice produced by evaporation under air pump.

Ice formed in cryophorus.

A.—Ammonia freezing machine.

Still or Liebig's condenser.

Heat absorbed by expansion

Air compressed and cooled in copper vessel impinges on bulb of air thermometer.

A.—Air as above impinges on thermo-pile (*compare also "mechanical heat"*).

Ebullition.

Difference of boiling points of various liquids, *e.g.*, water, alcohol, turpentine, &c.

Rectify alcohol.

Variation of boiling point with pressure.

Flask of boiling water corked and cooled, recommences to boil.

Warm water boils under the air pump, also warm alcohol.

Boil either under air pump.

Tension of vapours.

Introduce a series of liquids into a series of barometers, *e.g.*, water, alcohol, ether, bisulphide of carbon, &c., and so measure their vapour tension.

Depress the above into deep copper or glass well to show condensation.

Surround the above by a glass cylinder of water of various temperatures.

Experiments with Marcet's boiler.

Crush a tin vessel by atmospheric pressure against steam vacuum.

Syphon gauge for steam tension.

Regulation.

Adhesion of blocks of ice to one another and to flannel.

Cut a block of ice by a loaded wire.

Press ice through a wide meshed wire gauze.

Compress snow into ice.

Water dropped into red hot silver basin.

Spheroidal state.

Water drops held by pipette on outside of hot platinum cup. The non-contact proved by break in circuit with galvanometer.

Force a cork out of a copper flask (silvered internally) by the burst of steam after spheroidal state.

Steam, a rue gas. Heat a steam cloud and examine its shadow.

Show the transparency of steam in the constricted water hammer.

Radiant heat.

(1.) Radiant heat reflected:

- A red hot ball throws heat upon a bright tin plate which reflects it on to an air thermometer or pile.
- A candle flame at one end of a long bright tin tube and an air thermometer or thermo-pile at the other.

(2.) Radiant heat absorbed:

- Use of air thermometer with blackened bulb.

(3.) Radiant heat transmitted:

- Copper ball, thin sheet of glass and air thermometer or thermo-pile.

Radiation from various surfaces. Place boiling water in two similar saucepans, one externally blackened, the other bright. Examine after half an hour the temperatures by differential thermometer.

Experiments with Leslie's tubes. Compare radiation on air thermometer from lamp black, bright metal, scratched metal, isinglass, and glass sides of cubes.

A.—As above, with thermo-pile.

Compare radiation from bare glass and glass surface covered with gold leaf, on air thermometer or thermo-pile.

Compare temperature of water placed when hot in bright metal and glazed earthenware tea-pots.

Absorption of radiant heat. A bright and a lamp blackened metal saucepan are filled with cold water and placed at the same distance above a hot metal plate. The temperature of the water is compared after half an hour by the air thermometer.

The front of a piece of paper is partly covered with gold leaf, the back is covered with iodide of mercury. A hot iron is held over the paper.

A hot ball is placed midway between two vertical tin plates, one blackened, the other bright towards the ball. Bars of bismuth are soldered to the outside of each plate and connected with the galvanometer.

Show that silvered glass reflects little heat.

Dew. Determine dew point by Daniell's hygrometer.

Thermancy. Test by means of Argand lamp and thermo-pile the thermancy of (1) glass, rock salt, blackened rock salt; (2) water, bisulphide of carbon, blackened (by iodine) bisulphide of carbon, in glass cells; (3) dry air, coal gas, ether vapour, moist air, in a long tube.

Refraction of heat. Examine the distribution of heat in a solar or electric spectrum formed by a rock salt or bisulphide of carbon prism.

Heat-focus of burning glass with sun.

Heat-focus of bisulphide of carbon lens.

The heat of an Argand burner with mirror is sent through ice and then focussed.

Calorescence. Electric or solar radiation is analysed by passing through bisulphide of carbon and iodine, it may then be focussed on bulb of air thermometer, &c.

A.—The emergent beam fails to melt ice but fires paper, &c.

Reflexion of heat. Heated ball in focus of one of two parabolic mirrors, gun cotton or blackened bulb of air thermometer in the other.

Theory of exchanges. Ice in focus of one of a pair of parabolic mirrors, air thermometer in the other.

A.—Pyrheliometer, use of.

Heat of friction. Test heat produced by stropping a razor, sawing, &c., by air thermometer or thermo-pile.

Boil ether, fuse fusible metal by heat of friction, using whirling table.

Hammer a piece of lead and examine its heat.

Drop a leaden ball into a wooden tray from a height of 16 feet.

A.—Experiments with Joule's apparatus.

Mechanical heat. Air syringe with German tinder or bisulphide of carbon.

Condensation of oxygen by spongy plantinum and heating effect.

Spongy platinum over gas, alcohol, camphor, &c.

Moist air in receiver of air pump, show condensation; illuminate by gas jets.

Show expansion of cool condensed air produces cold in air thermometer or thermo-pile.

Compare with heat produced by bellows.

The pendulum illustrates the conversion of potential into kinetic energy.

A.—Illustrations of heat potential in unstable equilibrium in consequence of chemical affinity exhibited by calorimeter, e.g., sulphur carbon, iron, &c., burnt with nitre under water.

LIGHT.

Sources of light. Familiar examples of combustion, *e.g.*, wood, wax, paraffine oil, candle, gas, &c. Test for carbonic acid with lime water.

Burn sulphur, phosphorus, magnesium, zinc. Also in oxygen.

Burn antimony in chlorine.

Light of resisting platinum wire.

Comparative luminosity of gases and solids. Coal gas mixed with air in blow-pipe flame or Bunsen burner. Introduce platinum wire, lime powder, magnesia, silica, &c.

Smoky flame is luminous.

Lime light.

Phosphorescence. Loaf sugar rubbed in the dark.

Quartz pebbles as above.

Fluorescence. Powdered fluorspar thrown upon a hot iron plate in the dark.

Phosphate of lime as above.

Insolation. Sulphides of calcium, barium, and strontium in sealed glass tubes, exposed to light and brought into the dark.

Velocity of light. Show by means of model of earth, sun, Jupiter, and its satellites the determination of velocity of light by occultation of Jupiter's satellites.

Construct and explain model of Fitzeau's wheel.

Construct and explain model to show aberration of light.

Rectilinear motion of light. Obtain small inverted image of a candle flame through a pin hole.

Cast the shadow of a broad lath by a flat and edge flame.

Intensity. Show depth of water when the same quantity is poured into two tin trays of areas 1 : 4.

Galvanically incandescent platinum wires in ground glass globes of different diameters.

Wire frame, a long square pyramid with wire frame sections at 1, 2, 4 from the apex.

A square frame is placed half way between a flame and a screen.

A square tube blackened internally with end of ground glass inclined to axis of tube.

Experiment to show that brightness is not diminished by recession.

Photometry. Experiments with Wheatstone's photometer.

Use shadow photometer and show the use of coloured glasses for comparison.

Experiments with Bunsen's photometer, *e.g.*, equal lights at unequal distances, unequal lights at equal distances, &c.

Superposition of images. Pierce tin foil in front of a candle or lamp till the images coalesce.

Show the formation of a round disc of light through an irregular hole.

Law of reflexion. A parallel beam falls at the foot of a slender white rod fastened perpendicularly to a small silvered plane mirror.

A small vertical mirror in the centre of a horizontal graduated semicircle carries an index and receives a horizontal parallel beam, the index and mirror are revolved.

Artificial horizon.

Compare angular motion of reflected beam with that of mirror.

Explain and use Hadley's sextant.

Apparent position of point in mirror. Single and multiple reflexion of small luminous object, the latter from parallel and inclined mirrors.

Apparent relative position of two or more reflected points and formation of images. Use of moveable model of an object, rods from which are hinged upon an edge representing a reflecting surface. The arrangement to show the position of the image in the plane mirror.

Inversion of parti-coloured beam by reflexion from plane mirror.

Experiment with candle flame and mirror to verify the above.

Write with soap on glass plates, view one side directly, the other by reflexion in a mirror, &c.

Reflecting power of surfaces. Compare the brightness of light reflected from silver, silvered glass, plain glass, blackened glass.

Mixed reflected images. Powdered glass. Soap suds. Cast a beam of light upon a plane mirror which throws it on a screen; breathe upon the mirror where the beam impinges, and observe the dark spot on screen.

The shading of an object never reaches its outline.

Increased reflexion by obliquity of incidence.

Reflexion from curved surfaces. Spherical concave mirror. Focus of parallel rays nearly half way between centre of mirror and centre of curvature.

Exact focussing in case of parabolic mirror.

Conjugate mirrors with light in focus of one.

Spherical aberration and caustic; the latter also from cylindrical band.

Positions of focus of poin from spherical mirror. Luminous point on axis of spherical mirror—

(1.) Beyond centre of curvature.
(2.) At centre of curvature.
(3.) In principal focus.
(4.) Within principal focus.

Luminous point above or below axis of spherical mirror—
(1.) Beyond centre of curvature.
(2.) Near centre of curvature.
(3.) About principal focus.
(5.) Within principal focus.

Real images.

Real image of flame to verify.

Image of illuminated object.

Use of diaphragm to diminish aberration.

Virtual images.

Dispersion when luminous point is between mirror and principal focus.

Virtual focus and virtual image with concave mirror.

Convex mirrors.

Dispersion of parallel beam.

Dispersion of beam from luminous point on axis of mirror.

Dispersion of beam from luminous point above or below axis.

Image, erect, virtual, diminished.

Oblique reflexion.

Focal lines when the beam is incident obliquely.

View a bright coin round the edge of a pail of water.

Transmission and refraction.

Displacement of a portion of a straight line when viewed obliquely through a flat slab of glass, or shadow of line focussed on screen and the slab held near the line obliquely.

Displacement of a parallel beam towards base of interposed wedge of glass.

N.B.—The angle of the wedge should be so acute that little chromatic effect is produced.

Inequality of refracting power

Two equal slabs and wedges of crown and flint glass, displace line and shadow unequally.

Float ice on warm water and examine the shadow focussed on screen.

Pour hot water through a pipette to the bottom of cold water, focus shadow on screen.

Examine vertical straight line through a cell of water and bisulphide of carbon held obliquely.

Mix water with syrup and alcohol.

Examine shadow of coal gas, also ignited gas jet.

Examine shadow of ether vapour, red-hot poker, and red-hot platinum wire (foreshorten on screen).

Law of refraction.

Semicircular bath graduated on inside, a window on diameter, and a sliding sine arm, used to prove law of reflexion.

Disappearance of a glass rod or powdered glass when plunged into a mixture of bisulphide of carbon and ether.

Transparency of waxed paper.

Total reflexion.

Total reflexion on surface of water in finger-glass of a coin in it.

Compare superficial and internal reflexions by hypothenuse of right-angled prism.

Inversion without lateral displacement.

Use of water prism with moveable sides, showing total reflexion at one side or at surface of water.

Examine test tube in water, empty and full.

Air on hairy leaves.

Division surface between two liquids totally reflects.

A.—A jet of water curved receives a beam of light and carries it along by internal reflexion.

The use of the camera lucida.

Lenses.

Intersection of two parallel rays passing through two rectangular prisms of unequal sides put base to base; to illustrate the derivation of plano-convex lens.

A.—Model of light-house lenses with prisms arranged for camera.

Principal focus for plano-convex lens.

Focus of point on axis of plano-convex. Three examples of distance of point from lens.

Focus of point off the axis of plano-convex. Three examples of distance of point from lens.

Simultaneous foci of two points and formation of images.

Foci and images with double convex lens, as above.

Comparison between concave mirror and convex lens.

Point in axis corresponding with centre of curvature at distance 2 *f*.

Selected comparative experiments between lens and mirror.

Real image in air viewed from a distance.

Formation of virtual image by convex lens, erect and magnified.

Concave lens.

Dispersion of parallel beam by plano-convex lens, and double concave lens.

Prolongation of focal distance by interposition of plano-concave and double concave lenses.

Virtual image by concave lens.

Spherical aberration.

Variation in focal distance by using different parts of a lens.

Use of diaphragms.

Image of illuminated coin with diaphragm on lens.

Cylindrical lens.

Bright bullet in test tube of water.

The eye.

Construct model of eye by a bolt head or spherical flask of water, a lens and a luminous or illuminated object.

Demonstrate anatomical model of eye.

Image of a luminous body thrown upon a screen (1) behind, (2) within, (3) upon the surface of the eye; by displacement of object and variation of lenses. To illustrate long and short sight and their remedies.

Limits of distinct vision.

A double image of an object seen with one eye close to the object through two pin holes.

Distinct vision within the limits obtained by a pin hole or a lens held close to the eye, which therefore acts as a magnifying glass.

Determine the *punctum cæcum.*

Examine net work of vessels in the eye by a candle in a dark room.

Wheatstone's photometer.

Duration of images and irradiation

Rotate an illuminated slit above a series of slits.

Apparent superior size of white objects over dark ones.

Platinum wire heated by a galvanic current and viewed through coloured glasses.

Stereoscope and Pseudo scope.

Explain reflecting and refracting stereoscopes and pseudoscope.

Analysis of white light.

Analysis and recomposition of a flat beam of light by glass prisms.

Recomposition of analysed beam by a lens.

Interpose opaque screen or glass wedge at different ends of the spectrum before its recomposition.

Synthesis by rotating discs opaque and transparent.

Cast a spectrum on a plane mirror and thence on to a screen; cause the mirror to vibrate.

Chromatic dispersion o lenses.

Lens of glass containing bisulphide of carbon gives different focal lengths of images for different colours.

Examine the change in colour of the sheath of a conical beam after its rays cross one another.

Dispersion by different media.

A trough prism with divisions receives different liquids, a wide flat beam of light falls upon all. Examine (1) position, (2) length of spectrum.

Examine length of spectra by equal prisms of crown and flint glass.

Show achromatic couple of crown and flint glass prisms.

Show achromatic combination of water and crown glass prisms.

Colour by partial absorption of white light.

Interpose before a source of white light a red glass and a solution of ammonio sulphate of copper in succession and together.

Permanganate of potash in solution is passed along a spectrum; it appears opaque in all colours but its own.

Chromate of potash, as above.

Absorption bands by permanganate of potash solution.

Analyse permanganate coloured beam of light by a narrow prism to show blue, red, and the purple where they overlap.

Colour by reflexion.

Various opaque-coloured objects seen in monochromatic light as alcohol flame in lamp whose wick contains salt. Also in red and green fires.

Subjective colours.

Cast disks of light on screen through solutions of permanganate of potash and ammonio sulphate of copper, and suddenly interpose opaque screen.

Contrast colours.

Throw coloured light over the screen and cast shadows upon it.

Chemical effect of light.

Decompose oxalate of iron under water by light.

Cause equal volumes of hydrogen and chlorine to combine by light.

Decompose iodide of methyl in presence of mercury by light.

A.—Decompose nitrite of amyl by passing light through the glass end of a glass tube containing the rarefied vapour of it.

Float blotting paper in succession on brine and a solution of nitrate of silver, and expose a portion of it to the light of the sun or burning magnesium ribbon.

Spectra.

Examination of Fraunhofer's lines in solar spectrum.

A.—Obtain the absorption line of nitrous oxide by interposing a flask of that gas in the spectrum.

A.—Examine continuous spectrum from carbon points of electric lamp.

A.—Obtain the bright bands for silver, copper, zinc, brass, sodium, &c.

A.—Absorb yellow band in sodium spectrum by sodium vapour.

Fluorescence.

Examine in violet light uranium glass, quinine solution, turpentine dropped into water, and alcohol; also examine the above in the spectrum.

Undulatory theory.

Show colours when oil of turpentine or lemons is dropped upon water.

Show colours of soap bubble.

Cover glycerine-soap bubble with a beaker and observe spot and coloured rings.

Examine the iridescence of lead scum, Nobili's rings, mother-of-pearl, bismuth, ruled gold leaf, Newton's rings. Examine these also in monochromatic light.

Cylinder of liquid to show internal reflexion and dispersion.

Two narrow slits in same plane, one at each end of a tube, to show diffraction.

Lycopodium strewn on glass and a candle flame viewed.

Polarization.

Ordinary light can be reflected at every angle.

Diminution and destruction of this power by previous reflexion.

Polarizing angle for glass.

Cast a beam of polarized light upon the apex of a square pyramid of blackened glass.

Compare polarization of reflected ray by black, transparent, and silvered glass.

Gradual and complete polarization by repeated refraction.

Polarization by double refraction.

Examine light through tourmaline by tourmaline and by blackened glass; (1) glass used as polarizer, (2) glass used as analyser.

Introduce mica plate between polarizer and analyser.

Show double image by Iceland spar.

Test by tourmaline the plane of polarization in Biot's prism.

Confirm above by reflecting from blackened glass.

Iceland spar cut perpendicularly to optical axis shows single refraction.

A.—Single and double image Iceland spar prism.

Construction and use of Nicol's prism.

Show the effect on polarized light of selenite, quartz, strain, pressure, vibration in glass, heat, &c.

Circular polarization.

A.—Use of saccharimeter.

Selected optical instruments.

Examine image formed on the ground glass of a camera obscura by a magnifying lens; also examine the real image in the air by a magnifying glass.

Use of Ramsden's eye-piece for viewing cross wires and image together, as used in theodolite, &c.

Huygen's eye-piece for improving the image, increasing the field, and being achromatic.

Erecting eye-piece.

Refracting telescope.

Conversion of reflecting telescope into microscope.

Convex object-glass and concave eye glass; give an erect and magnified image. Opera glass.

Construction of a reflecting telescope with concave mirror and eye-piece.

Application of polarized light to microscope.

Frictional Electricity.

Sample attraction.

Amber rubbed with flannel attracts lath balanced on glass flask, also gold-leaf, bran, feathers, &c.

Brown paper (hot) rubbed with a clothes brush attracts as above.

Foreign post paper rubbed with bottle india-rubber attracts as above, also clings to wall.

Silk ribbon rubbed with vulcanized india-rubber, as above.

Collodion rubbed with the fingers, as above.

Glass tube rubbed with electric amalgam on silk attracts as above, also paper roller, egg shells, &c.

Sealing wax rubbed with flannel attracts as above.

Stick of sulphur rubbed with flannel attracts as above.

Two kinds of electricity.

Excited glass attracts every unelectrified body, including bar magnet.

Excited sulphur and sealing wax attract as above.

Excited glass and excited wax attract one another.

Excited glass repels excited glass.

Excited wax repel excited wax.

N.B.—*The wax and glass when excited may be placed on little wire stirrups and hung from supports by silk tapes.*

Foreign post excited with india-rubber is cut into strips forming a tassel.

The two halves of the silk ribbon excited with vulcanized india-rubber repel one another.

Electroscope.

By this instrument test the nature of the electricities in the above experiments, employing proof-plane.

N.B.—*Show that the only sure test as to the kind of electricity in the electroscope is the getting increased repulsion.*

Nature of surface.

Ground glass rubbed with flannel becomes negatively electrified.

A glass tube held in an alcohol frame becomes negatively electrified.

Conduction.

A glass rod is excited and connected with the electroscope by means of copper, iron, platinum wires, by dry silk, wet silk, cotton, wooden rods, thin sheets or rods of glass (varnished), vulcanized india-rubber, dry paper, &c., &c.

A brass or leaden tube held in the hand and struck with flannel exhibits no excitement.

Held in vulcanized india-rubber or otherwise insulated it does.

Experiments with insulated human body.

Induction.

The electroscope being neutral, approach and withdraw excited glass and sealing wax.

Entrap $+^{ve}$ electricity induced in electroscope by separation of conductor from electroscope while under induction.

Entrap $-^{ve}$ electricity as above, using wax.

Induce $+^{ve}$ in electroscope by glass rod; connect with earth, remove rod and test.

Induce $-^{ve}$ in electroscope as above by wax; connect, &c.

Test the charge at each end of an insulated cylinder under induction.

Connect either end of insulated cylinder under induction with the earth, and prove that one electricity only leaves it.

Construct a semaphore of pith balls on conductor to prove the same.

Light gas by induced free electricity from conductor. Light gas again by withdrawing inducer.

Induce electricity in two spheres, insulated and in contact. Separate them and test their electricities.

A lath rotates by attraction of rod; test the condition of the distant end.

Deduce and illustrate the attraction of all neutral bodies by excited ones.

Electrify surface of varnished glass beaker, and place it over pith balls on metal plate connected with the earth.

Suspend a proof plane and let it vibrate between two oppositely electrified spheres.

Take $-^{ve}$ electricity by means of a proof plane from the table over which is an excited glass rod.

Condensation.

Brass plate condenser; use.

Make a condenser out of two sheets of tin-foil and a varnished sheet of glass. Connect with electroscope.

Electrophorus.

Make an electrophorus by means of a zinc or tin plate, an isolating handle of sealing wax or varnished glass. A sheet of vulcanized india-rubber or of varnished glass.

Test the electrical state of the excited india-rubber by induction on the electroscope.

Test the free electrity of the zinc plate (1) when in contact and (2) when touched and withdrawn.

Employ better form of instrument; repeat tests as above.

Experiments with electrophorus, such as lighting gas, exploding mixed gases, &c.

Distribution.

Show the difference of tension on parts of long conductor by means of the repulsion of pith balls. Test also by proof plane and electroscope.

Test by proof plane and electroscope the tensions on different parts of insulated saucepan, flat metallic disk, hat, &c.

Roll up a charged sheet of tin-foil in connexion with the electroscope.

Roll up the same placed on a sheet of varnished glass on the table.

Examine the place of the electricity when a charge insulated ball is clasped between two insulated metallic hemispheres.

Point discharge.

Show rotation of electric wheel.

Chase gold leaf with excited rod.

Gold leaf kite hovering around knob of Leyden jar. The jar preferably uncovered.

Suspended wire with metallic and ordinary paper points to rotate in opposite directions.

Needle on cap of electroscope and prime conductor.

Melted sealing wax at the end of a needle on prime conductor.

Electrical machines.

Bertsch's machine.

Holtz's machine.

Cylinder machine.

Double plate machine.

A body may be charged either by the addition or subtraction of electricity or by both combined.

Study the method of charging a prime conductor mounted with a point by excited glass or sealing wax.

Examine the electricities in the prime conductor and rubber.

Leyden jar.

Elementary jar made by two sheets of tin-foil separated by glass.

Single Leyden jar charged and discharged.

Dissected jar.

Partial discharge of Leyden jar from the glass to the inner coating.

Examine the residual charge, primary, secondary, &c.

A jar cannot be charged unless its outer coating is in connexion with the earth.

Charge a jar with both positive and negative from the same prime conductor.

Faraday's experiment to show the gradual charging of a submarine cable.

Show cascade arrangement.

Measure capacity of jar by unit jar.

Use of pith ball electroscope.

Charge a jar, insulate it, connect interior with earth, and test exterior.

Experiments with jars.

Construct electric battery.
Deflagrate platinum and silver wire.
Explode gunpowder; show use of wet string.
Burst a tube filled with water.
Light ether.
Discharge through eggs, sugar, ivory, lemon, &c.
Discharge through rarefied air, oxygen, hydrogen, and nitrogen.
Pierce paper.

Duration of spark.

Illuminate by a spark a revolving cross or coloured disk.

Velocity.

Model of Wheatstone's revolving mirror and apparatus for velocity.

Atmospheric electricity.

Flame on end of fishing rod connected with the electroscope and isolated.
Examine electricity in steam jet near and some distance from nozzle by conductor and electroscope.
Explain Thomson's electrometer.
Explain and illustrate "return" stroke.
Repel and discharge cotton wool by pointed conductor.

Miscellaneous.

Lichtenberg's figures on electrophorus, varnished glass, ebonite.
Formation of jar by one man standing on insulating stool and grasping another man's hand, a sheet of vulcanized india-rubber intervening.
Test for ozone in brush discharge.
Light gun-cotton by induced spark from flat coil.
Show the effect on astatic needle of friction current from prism conductor.
As above, using $-^{ve}$ electricity.
Change the connexions in both above cases with astatic needle.
Connect secondary coil with astatic needle, and show reversal.
Experiment with tertiary coil.

Pyro-electricity.

Tourmaline connected with Thomson's electrometer.
(1.) Heat. (2.) Cool.

VOLTAIC ELECTRICITY.

Connexion between high and low tension electricities.

Deflect astatic needle by selected pairs of metals in salt water, *e.g.*, pin and needle, copper and iron, zinc and lead, &c., and compare with deflection by electricity from prime conductor.
Volta's crown of cups with zinc and copper.
Electric potential at the opposite poles, tested (1) with condenser and electroscope, (2) with Thomson's electrometer.

Condition of the conducting wire.

The copper wire connecting the poles attracts filings. Is heated.
Deflection of magnetic needle by current:—

(1) above needle in direction (1).
(2) " " " (2).
(3) below " " (1).
(4) " " " (2).

Effect of multiplying coils of conducting wire.

Attraction of filings by coil.
Explain and use astatic needle with feeble currents.

Commutator.

Construct simple form of, and explain commutator.

Helices.

Make models of right and left handed helices and reversible conical helix.

Magnetism in soft iron by current.

Pass a current across a piece of soft iron:—

(1) in direction 1 above the iron.
(2) " " 1 below "
(3) " " 2 above "
(4) " " 2 below "

Test the poles of the soft iron.

Magnetise a bar of soft iron in a helix by a current:—
(1) right-handed helix, current direction 1.
(2) " " " " 2.
(3) left " " " 1.
(4) " " " " 2.

Large hoop coil; introduce soft iron.
Make horse-shoe electro-magnet, and show simple experiments of attraction.

Polarity of coil.

The polarity of the coil is the same as that of the core.
A suspended helix (solenoid) acts as a bar magnet.
A hoop helix and a tube helix are fastened to a bung and floated on acid water, their terminals are of copper and zinc.
They turn N. and S.
The above are attracted and repelled by the poles of a magnet.
A tin tube sucked into a coil.

Magnets. Electrical machines.

A.—Froment's machine.

Theory of batteries.

Increased effect (thermal) by increased number of cells.
Show increase of potential by multiplying the cells.
Diminution of effect by lapse of time with single liquid cell.
Deposition of hydrogen on platinum shown by floating the platinum foil.
Polarity of hydrogenized platinum is the same as that of zinc.
Reuter's pile; silver and flannel.
Devices for the elimination of hydrogen:—

(1.) Mechanical; Smee; use of platinized silver.
(2.) Daniells', substitution of copper for hydrogen.
(3.) Bunsen and Grove; burning of the hydrogen.

Amalgamation of the zinc with mercury.

Electrolysis

Electrolyse water; examine the proportion and nature of the gases, also their polarity.
Electrolyse salts of silver, copper, lead, &c., using platinum wire electrodes.
Examine the deposition in a drop of solution under the microscope.
Throw focus on screen and shadow of metals during their electrolytic deposition.

Motion of water in direction of current.

In electrolysing water it follows the current.
Force water through a porous cell and show current by platinum poles in the cell and outside.

Electrolytic measurement of current.

Faraday's voltameter.
Guthrie's voltastat.

Magnetic measurement of current.

Tangent galvanometer:—
Explain laws of deflexion for tangent and zinc galvanometers.

General law of resistanc

Battery of (n) cells and thin platinum wire.
Send a current round a galvanometer and between two platinum spatulae in water:—

(1) Increased effect by acidification.
(2) " " approach.
(3) " " deeper immersion.

Repeat as above, using platinum spiral of thin wire instead of galvanometer.
Introduce into circuit from battery around galvanometer different metal wires:—

(1) Variation with substance of wire.
(2) " " length "
(3) " " sectional area of wire.

Show heating effect of current on compound wire of platinum and silver.
A.—Use of Wheatstone's rheostat.

Ohm's law.

Galvanometer with single hoop of thick wire to be used.
Vary number of cells with no external resistance.
Vary number of cells with large external resistance.
Vary nternal resistance by—

(1) varying size of plates.
(2) " distance of plates.

Mechanical relations of currents.

1. Currents in same direction attract.
2. Currents in opposite directions repel.
3. Currents crossing one another tend to become parallel.
4. Currents at right angles tend to slide.
5. Ampères' trough and wire to show that one part of a straight current repels the other part.

Induced currents

1. Setting up current in primary gives reverse in secondary.
2. Cessation of current in primary gives current in same direction in secondary.
3. Approach of primary gives reverse current in secondary.
4. Withdrawal of primary gives same direction of current in secondary.

Ampères' theory of magnetism

Examine the sliding of a current-bearing wire around a magnet.

(1) Current (1) rotating round north pole.
(2) " (2) " " " "
(3) " (1) " " south "
(4) " (2) " " " "

Rotation of a discharge in vacuo around a permanent or electro-magnet.
Examine by galvanometer the current produced through a flat copper coil:—

(1) When placed on north pole of magnet.
(2) " " south " "
(3) When taken off north " "
(4) " " south " "

Turn the coil over and repeat.
Magnetize a bar of soft iron while in a coil and examine the direction of current. Vary poles.

Magneto-electric machines.

Simple magneto-electric machine. Decompose iodide of potassium. Heat platinum wire. Heat between carbon points, &c.
Explain Siemens' armature.

Automatic contact breaker.

Explain model of automatic contact breaker.

Ruhmkorff's coil.

Model of dissected coil, showing—
- Discharge through vacuum tubes.
- Instantaneous nature of induced current by rotating cross.
- Analyse discharge by a rotating mirror or uranium glass.
- Formation of ozone.
- Induced current in primary or extra current.
- Use of condenser.

Further effect of induced current.

Rotation of magnetic needle above a copper disc on the whirling table.

Use of copper plate in compass.

Resistance to motion of conductors in the magnetic field. Copper saw between poles. Copper coin spun between poles. Copper ring dropped between poles. Same broken.

Applications.

Working model to exhibit the production of oscillatory motion by an electro-magnet. Conversion of this into a Morse and relay.

Wheatstone's needle telegraph and needle relay.

Electric lamp.

Show unequal consumption of poles in air also in vacuo.

Explain differential motion of poles and their regulation by a magnet and spring.

Cake silver on negative pole by the projected carbon.

Wheatstone's bridge.

Balance the astatic needle by equal currents.

Interpose unequal resistances produced by variations in length, thickness, temperature, and kind.

Thermo-electricity.

Pairs of different metals such as zinc, iron, copper, tin, platinum, silver, bismuth, antimony connected with galvanometer and heated at point of contact.

Cooling produces opposite current.

Passage of current produces heat or cold.

Platinum wire and foil to show that current travels with heat.

Heat one side of tangle in platinum wire.

Further relation between heat and resistance.

Thin platinum wire in alcohol thermometer.

Increased heating of platinum wire when a part is cooled.

MAGNETISM.

Attraction.

Show attraction by lodestone on iron filings.

Directive polarity of lodestone to the earth and to other lodestone.

Steel capable of permanent magnetization, iron not.

Polarity.

Like poles of needles repel, unlike attract. Either pole attracts soft iron.

Poles.

Break a hard steel spring magnet into lengths and test the polarity of each.

Determine regions of greatest and least attraction by oscillation of needle.

Determine law of variation of intensity with distance (1) on torsion balance (2) by oscillations.

Induction.

Compare time of magnetization of steel and of soft iron when in contact with a magnet.

A soft iron bar shifts the pole.

Two permanent magnets placed N to S neutralize and exert little attraction on a soft iron bullet.

Examine the magnetism in a soft iron bar suspended above a permanent magnet.

The greatest possible number of soft iron bullets are suspended from one magnet. Its carrying power is altered by bringing the like or unlike pole of another magnet beneath.

Relation of heat to magnetism.

Destroy the magnetism in a small steel spring magnet by red heat.

A nearly white hot iron ball is not attracted by a magnet.

Magnetization.

Various methods of magnetization, such as single stroke, double stroke, circular stroke, &c.

Magnetic curves or lines of force.

Parallel bar magnets beneath sheet of glass. Scatter iron filings on glass, tap and print with paper moistened with nut-gall and gum-water.

As above, with like poles in conjunction.

As above, with horse-shoe.

As above, with piece of soft iron to be magnetized by induction.

A.—Grove's experiment to show the passage of light amongst oxide of iron suspended in water and surrounded by a coil.

Induction through media.

Examples of attraction and induction through wood, glass, brass, &c.

Diminution through iron.

Magnetism of earth.

Pass a current through a wire wound on a sphere, and compare its magnetism and polarity with that of the earth.

Possible cause of earth's magnetism is a series of currents passing from east to west.

A.—Measurement of intensity of earth's magnetism by magnetometer.

Position of earth's poles.

Declination and inclination.

Compare with needle about bar magnet.

Induction by earth.

A soft iron bar parallel to the lines of magnetic force becomes a magnet.

The lower end of a poker when struck with a hammer repels the end of a needle which points to the north.

A current is established in a closed conductor when it is moved, so as to cut the lines of magnetic force.

A bar of soft iron in a coil in the magnetic, meridian, and dip, is connected with a galvanometer and inverted.

Magnetism of iron compounds.

Crystallized sulphate of iron inclosed in a tube and swung between poles of an electro-magnet sets axially.

A.—Solution of sulphate of iron in a tube swung between the poles of an electro-magnet sets axially.

A.—Powdered dry white sulphate of iron is scattered on black glazed paper above poles of electro-magnet.

Magnetism of nickel and cobalt.

Test.

Pseudodiamagnetism.

A.—Apparent magnetism due to structure, *e.g.*, short iron wires side by side on wax floating on water. The whole sets equatorially.

A.—A number of iron disks separated by cardboard and forming a bar sets equatorially.

Diamagnetism.

A.—A bar of bismuth swung between poles of electro-magnets sets itself equatorially.

A.—A pellet of bismuth is repelled from either pole.

A.—The flame of a candle is split.

A.—The flame of ether is split.

A.—Oxygen charged with chloride of ammonium vapour assembles round the poles.

A.—Show influence of medium by examining apparent diamagnetism of weak solution of sulphate of iron in a strong one.

SKETCH OF EXPERIMENTS IN INORGANIC CHEMISTRY.
By Dr. FRANKLAND.

1. Ignition of platinum wire and of magnesium wire in air, to show effect of chemical action in the second case.
2. Transformation of liquids and gases into solids and *vice versâ* by chemical action.
3. Ignition of phosphorous by red hot bar of iron placed at a distance of several inches.
4. Attraction of a suspended wooden rod by an electrically excited glass tube held at a distance of several inches.
5. A glass rod moistened with concentrated sulphuric acid held close to a small heap of a mixture of sugar and potassic chlorate produces no effect, but inflames the mixture as soon as the rod is brought into actual contact with it.
6. An example of direct chemical union:—Combination of hydrogen and chlorine by heat.
7. Chemical displacement:—Precipitation of copper from a solution of cupric sulphate by a bright plate of iron.
8. Mutual chemical exchange:—Add solution of potassic iodide to solution of mercuric chloride.
9. Re-arrangement of elements in a compound:—Coagulation of albumen by heat.
10. Resolution of a compound into its elements, or into two or more less complex compounds:—Heat mercuric oxide and show oxygen and mercury produced.
11. Electrolysis of water, with demonstration of properties of the separated gases.
12. Preparation of hydrogen by the action of sodium upon water.
13. Preparation and collection of hydrogen from zinc and dilute sulphuric acid.
14. Preparation and collection of hydrogen from zinc and solution of caustic soda.
15. Burn jar of hydrogen, mouth upwards, and another with the mouth downwards.
16. Pour hydrogen upwards from one jar into another.
17. Extinguish a burning taper in hydrogen.
18. Preparation and collection of chlorine from manganic oxide and hydrochloric acid.
19. Bleach carmine paper in the gas.
20. Electrolysis of solution of hydrochloric acid. Collect gases separately and show their properties.
21. Burn jet of hydrogen in chlorine.
22. Prepare hydrochloric acid gas from common salt and sulphuric acid. Collect over mercury or by displacement of air.
23. Show by test papers alkalinity of solution of potash, acidity of solution of hydrochloric acid, and neutrality of liquid produced by the mixture of these solutions in suitable proportions.
24. Extinguish taper in hydrochloric acid gas.
25. Show solubility of hydrochloric acid gas in water.
26. Prepare and collect oxygen from mercuric oxide, potassic chlorate, a mixture of potassic chlorate and manganic oxide, and by the transmission of chlorine and steam through a red-hot tube.

27. Burn a taper in oxygen, and show re-kindling from glowing wick.

28. Combustion of phosphorus in oxygen.

29. Combustion of bundle of steel wire in stream of oxygen.

30. Explosion of mixture of oxygen and hydrogen.

31. Show formation of water from jet of hydrogen burning in oxygen.

32. Show neutral reaction of water.

33. Show formation of ozone by action of moist phosphorus upon air. Show action of ozonized air upon paper imbued with starch and potassic iodide.

34. Preparation of hydroxyl by passing a stream of carbonic anhydride through water containing baric peroxide in suspension.

35. Heat hydroxyl in test tube, and show evolution of oxygen.

36. Add argentic oxide to hydroxyl, and show production of oxygen and metallic silver.

37. Wash with solution of hydroxyl paper discoloured with plumbic sulphide.

38. Wash with solution of hydroxyl white oil paint similarly discoloured.

39. Prepare chloric peroxide ($Cl_2 O_4$) in test tube, and explode it with a hot wire.

40. Add sulphuric acid to a mixture of phosphorus and potassic chlorate under water.

41. Prepare hypochlorous acid by agitating chlorine with mercuric oxide and water.

42. Transmit current of chlorine through boiling milk of lime, add potassic chloride to filtered product, and then crystallize out potassic chlorate.

43. Preparation of boric acid from borax and hydrochloric acid.

44. Flame of a solution of boric acid in alcohol.

45. Preparation of charcoal from wood in test tube.

46. Show crust upon lime water after exposure to air.

47. Add hydrochloric acid to pieces of old mortar, and show that carbonic anhydride is evolved.

48. Breathe through lime water.

49. Burn candle in glass cylinder filled with air, and show formation of carbonic anhydride by lime water.

50. Prepare and collect carbonic anhydride from limestone, chalk, or marble, and hydrochloric acid.

51. Show that soap bubbles filled with air float on carbonic anhydride.

52. Pour solution of litmus into jar of carbonic anhydride.

53. Immerse lighted taper in jar of carbonic anhydride.

54. Pass carbonic anhydride through an iron tube filled with charcoal, and heated to redness. Show the inflammability of the carbonic oxide produced.

55. Prepare and collect carbonic oxide from a mixture of oxalic acid and sulphuric acid.

56. Prepare and collect carbonic oxide from a mixture of sulphuric acid and yellow prussiate of potash.

57. Inflame jar of carbonic oxide, and immerse lighted taper in the gas.

58. Agitate lime water with carbonic oxide, and show that no turbidity is produced; inflame the gas, agitate again, and demonstrate the production of carbonic anhydride.

59. Prepare nitrogen by burning phosphorus in atmospheric air.

60. Prepare and collect nitrogen from ammonic nitrite, or from a mixture of potassic nitrite and ammonic chloride.

61. Prepare and collect nitrogen by passing chlorine into strong solution of ammonia.

62. Immerse a burning taper in nitrogen.

63. Pass electric sparks through air in a small vessel containing litmus paper.

64. Show neutrality of nitrogen.

65. Prepare and collect nitrous oxide from ammonic nitrate. Show production of ammonic nitrate from nitric acid and ammonic carbonate.

66. Show that feebly burning sulphur is extinguished in nitrous oxide, and that sulphur strongly ignited continues to burn in the gas with augmented brilliancy.

67. Immerse a burning taper in nitrous oxide.

68. Prepare and collect nitric oxide from copper and nitric acid.

69. Add nitric oxide to air in a jar over water.

70. Immerse a burning taper in nitric oxide.

71 Show that feebly burning phosphorus is extinguished in nitric oxide, and that strongly ignited phosphorus burns in it brilliantly.

72. Preparation of nitrous anhydride from nitric acid and arsenious anhydride.

73. Show the reducing action of nitrous acid by adding a solution of potassic permanganate to an acidified solution of a nitrite.

74. Show the oxidizing action of nitrous acid by adding a solution of a nitrite to acidulated water tinted with magenta.

75. Prepare nitric peroxide ($N_2 O_4$) by mixing nitric oxide and oxygen.

76. Prepare nitric acid from potassic nitrate and sulphuric acid.

77. Prepare nitric acid by the direct combination of nitric peroxide and hydroxyl.

78. Pour nitric acid upon copper clippings.

79. Deflagrate a mixture of nitre and charcoal.

80. Add strong nitric acid to gold leaf.

81. Add strong hydrochloric acid to gold leaf.

82. Mix the two last-named liquids together and show that the gold leaf then dissolves.

83. Prepare gaseous ammonia from a mixture of ammonic chloride and slacked lime. Collect over mercury or by displacement.

84. Demonstrate solubility of ammonia in water.

85. Immerse a taper in gaseous ammonia.

86. Burn a stream of gaseous ammonia at the end of a hot tube.

87. Show alkalinity of ammonia.

88. Demonstrate volatility of ammonic chloride.

89. Show production of ammonic chloride from gaseous ammonia and hydrochloric acid gas.

90. Prepare plastic sulphur.

91. Melt sulphur in test tube and show changes as the temperature increases.

92. Prepare and collect sulphuretted hydrogen from ferrous sulphide and dilute sulphuric acid.

93. Burn jet of sulphuretted hydrogen, and hold over the flame a glass rod moistened with ammonia.

94. Show acidity of sulphuretted hydrogen.

95. Decompose sulphuretted hydrogen by sulphurous anhydride.

96. Decompose sulphuretted hydrogen by chlorine.

97. Pass sulphuretted hydrogen gas through an aqueous solution of each of the following substances:—Arsenious acid, cupric sulphate, plumbic acetate, tartar emetic, and zincic sulphate.

98. Prepare sulphurous anhydride by the action of copper upon sulphuric acid. Collect over mercury or by displacement.

99. Show action of sulphurous anhydride on litmus paper.

100. Condense sulphurous anhydride in glass tube immersed in a mixture of snow and salt.

101. Immerse tape in sulphurous anhydride.

102. Demonstrate solubility of sulphurous anhydride in water.

103. Bleach infusion of rose leaves by sulphurous acid, and then restore the colour by addition of dilute sulphuric acid.

104. Convert sulphurous acid into sulphuric acid by—

1st. Exposing its aqueous solution to the air and,
2nd. By heating its aqueous solution with nitric acid.

105. Demonstrate the formation of sulphuric anhydride by passing sulphurous anyhydride and oxygen over ignited spongy platinum.

106. Show the formation of sulphuric acid by the direct union of sulphurous anhydride and hydroxyl.

107. Prepare sulphuric acid by mixing sulphurous anhydride, oxygen or air, nitric peroxide, and steam, in a flask.

108. Add one volume of concentrated sulphuric acid to two volumes of strong syrup of white sugar placed in a capacious vessel.

109. Demonstrate the spontaneous decomposition of free hyposulphurous acid, by adding dilute sulphuric acid to a solution of sodic hyposulphite.

Edward Frankland.

APPENDIX III.

REPLIES TO SECRETARY'S LETTERS, DATED JULY 22ND, 1870, AND SEPTEMBER 27TH, 1872.

A. REPLIES to SECRETARY'S LETTER of the 22nd of July 1870.

On the 22nd of July 1870, the letter given below was sent to the Head Masters of the following Colleges and Schools:—

Charter House School.
Cheltenham College.
Christ's Hospital.
City of London School.
Clifton College.
Dulwich College.
Eton College.
Gresham College.
Harrow School.
King's College School.
Marlborough College.
Merchant Taylors' School.
Rossall School.
Rugby School.
St. Paul's School.
St. Peter's College, Westminster.
Shrewsbury School.
Taunton College School.
University College School.
Wellington College.
Winchester College.

Aid to Science Commmission,
6, Old Palace Yard, Westminster, S.W.
July 22, 1870.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to express a hope that you may be disposed to assist the Royal Commissioners in prosecuting the important inquiry with which they have been charged by Her Majesty, by kindly furnishing, for their use, a statement showing to what extent scientific instruction has been introduced at ______, and how many pupils have availed themselves of it, and with what effect, in each year, since its introduction.

I have the honour to be
Your obedient servant,
J. NORMAN LOCKYER,
Secretary to the Commissioners.

The following replies were received:—

1. ST. PETER'S COLLEGE, WESTMINSTER.

19, Dean's Yard, Westminster, S.W.,
DEAR SIR, July 22nd.

I REGRET to say that owing to the very limited space at present available at Westminster, no systematic teaching of natural science has been possible. Lectures by Dr. Noad (of St. George's Hospital) have, for the last six years (except last year, when his other engagements prevented it), been delivered to voluntary classes of about 40 to 50 pupils, of whom not more than six or eight in each year have really exerted themselves to profit by the instruction.

I am, dear sir,
Faithfully yours,
CHARLES B. SCOTT.

2. CHRIST'S HOSPITAL.

Christ's Hospital, London, E.C
SIR, July 24, 1870.

IN answer to your letter dated July 22nd, I have to say that previous to last September the only regular scientific instruction given in Christ's Hospital was that included in the course of our mathematical department, in which some 50 boys learn navigation, and the other subjects required for the naval examination, and others read a great part of the subjects required in the mathematical examinations at Oxford and Cambridge. In September last, by agreement with the authorities of St. Bartholomew's Hospital, a *chemistry class* was commenced under the instruction of Dr. Matthiessen. The lectures and practical work were held in the laboratory of St. Bartholomew's. The attendance of the boys was perfectly voluntary, and all their work was done during play hours. (I should add that the old period of the school time was shortened simultaneously, with the express purpose of favouring this and similar expansions of the educational system.) We have every reason to be satisfied with the results so far. The senior class, containing 14 boys, was tested by practical work and by the paper given at the last London University Matriculation Examination (on the same day and hour). All were reported as having done enough to pass, while several would have been distinguished. The junior class, containing 30 boys, also satisfied the examiner by their proficiency in practical work.

The governors have accordingly resolved to continue the class under the same arrangements.

This is, so far as I know, the only instruction given here in physical science, with the exception of a course of lectures delivered in the hall three or four years ago by Professor Odling.

I have the honour to be, Sir,
Your obedient servant,
G. C. BELL,
Head Master.

3. SHREWSBURY SCHOOL.

The School, Shrewsbury,
SIR, July 28th, 1870.

I HAVE much pleasure in informing you that all boys attending this school are instructed in elementary mathematics according to the degree of proficiency which they have attained in arithmetic, that is, algebra, Euclid, trigonometry, and conic sections. We have no special scientific class. You will find a list of the mathematical honours gained by Shrewsbury in the report of the Public Schools' Commission.

I am, Sir,
Your obedient servant,
H. W. MOSS.

J. Norman Lockyer, Esq.

4. CHARTER HOUSE.

Charter House,
SIR, July 29th, 1870.

IN answer to your letter (July 22nd), I have much pleasure in sending information about the scientific teaching of this school.

i. For more than 10 years past there has been a class for elementary chemistry in the school. The lessons are given twice a week. There are annual prizes (generally two) for proficiency. The average attendance has been 27, the average number of boys in the school having been 135.

This year I took advantage of a course of lectures (about 20 in number) delivered at the Finsbury Institution by

Mr. Bloxam. *Four* of my boys attended this course and derived much benefit from it.

ii. The subject of applied mechanics has been taken up here, but not hitherto to any great extent.

It is right to add that I have found many difficulties in the way of carrying out my wish to advance scientific study in this school. Very soon after I came here the removal of the school from its present site was mooted. This question has now been determined some time, and our new buildings are in progress on a site near the town of Godalming. It is obvious that with the prospect of removal before us, I could not well have asked the governors to make any important addition to our present school accommodation, which, in my opinion, is very far from sufficient.

Our new site promises many facilities for scientific teaching, and our new buildings will not be made without reference to it. The neighbourhood to which we are going offers admirable opportunities for the practical pursuit of botany and geology, and I shall be glad to give every encouragement to the study of these subjects, as well as to those (i. and ii.) already adopted, and to any others which may seem suitable for a school course.

I am, Sir,
Yours faithfully,
WM. HAIG-BROWN.

J. Norman Lockyer, Esq.

5. WINCHESTER COLLEGE.

The College, Winchester,
SIR, September 3rd, 1870.

YOU will, I hope, have interpreted the delay in answering your communication on the subject of physical science teaching to have been due to your letter having been sent just as our holidays began.

The course which my predecessor, the Bishop of Salisbury, adopted for teaching physical science in the school was :—

1. To have a succession of leading scientific men from London and Oxford, to give short courses of lectures on their special subjects to the whole school collectively.

2. To give prizes for collections of flowers.

I believe considerable interest was stimulated by these methods.

Subsequently he engaged permanently an able teacher from Oxford to come down once a week throughout the year, to give lectures on different subjects to two classes.

When I became Head Master, about four years ago, that teacher made an engagement elsewhere, and I preferred to have a resident master. Since that time there have been always three classes, having two lectures a week, one taught geology by one of our masters who is acquainted with it, the other two having lectures in botany, mechanics, and physical geography, and occasional courses in light, heat, and electricity, from the natural science lecturer. All boys in the second main division of the school attend these lectures as part of their regular work. The division consists of about 100 boys altogether. A boy stays about two years in it. When he passes from it into the sixth it is optional whether he learns physical science. About one fourth of the sixth go on with it, forming a separate class, and going on till they leave school. Prizes are given twice a year for examinations in the lectures. I see papers of some of the best and worst, and think the results are quite satisfactory.

I have latterly had another master to teach P.S. to a class who are never likely to reach the division in which it is regularly taught, and who form a "Modern Class" (of about 25).

A "Natural History Society" has been started in the school, to encourage boys to collect things and to communicate with one another about them. They have shown interest, and made creditable collections of flowers, insects, and fossils.

Prizes have been given at different times by one of our masters and myself for such collections, but I think they collect as well for themselves without prizes.

We are beginning to form gradually a museum, library, and sets of apparatus, but these are works of time and are not yet far advanced.

I look forward to the time when a laboratory can be established. At present we have no means of teaching chemistry beyond a certain amount of lectures, but I hope that will not continue to be the case long.

I have the honour to remain, Sir,
Your obedient servant,
GEORGE RIDDING, D.D.,
Head Master of Winchester College.

6. THE COLLEGE SCHOOL, TAUNTON.

The College School, Taunton,
SIR, September 12th, 1870.

I AM requested to furnish a statement showing (I.) to what extent scientific instruction has been introduced at Taunton School, (II.) how many pupils have availed themselves of it, and (III.) with what effect, in each year since its introduction.

I. The teaching of physical science was introduced into the school in 1865. A house adjoining the old school was bought, a rough laboratory was fitted up, a typical museum was commenced, a small piece of ground was laid out as a botanical garden, and a thermometer stand, with a complete set of meteorological instruments, was erected. I began in that year by teaching comparative physiology to the higher classes, and experimental mechanics to the junior. In 1866 a class was formed in chemistry, and in 1867 I took the senior boys through a course of botany. In 1868 the teaching was systematised, and has been continued ever since, as follows :—

Classes I. II. (consisting of the youngest boys). An amusing lesson in general elementary science, with objects and experiments of all kinds. One hour a week.

Class III. Elementary mechanics, without a text book. Three hours a week.

Class IV. Advanced mechanics, with Newth's Natural Philosophy as a text book. Three hours a week.

Class V. (*b.*) Elementary chemistry. Three hours a week. Mechanics kept up. One hour a week.

Class V. (*a.*) Advanced chemistry with laboratory work Barff, text book. Four hours a week.

Class VI. Botany, Oliver, text book. Two hours a week. Chemistry as before. Two hours a week.

The few seniors who have completed this course, work at comparative physiology. Three hours a week.

Classes V. and VI. Register the meteorological observations twice a day, three boys taking each week, and work the monthly computations for the Registrar General's Report.

A small class practises with the theodolite once a week.

A voluntary class of nine boys is at this moment reading Lockyer's Elementary Astronomy, in view of a prize offered for the subject by a gentleman in the neighbourhood.

The regular lessons in physical geography include a sketch of geology, mineralogy, and zoology, and our museum collection in these departments is rapidly increasing.

II. From the first I have refused to make the science teaching optional. It has been imposed upon all the boys, and has exercised the same influence on marks and promotion as the other work. Boys now at the top of the school have gone through the entire course, and in future all will do so.

III. The technical result of our science work, as shown by examination, is as follows :—In 1865 one senior passed in physics, and two juniors in mechanics, in the Oxford local examination. In 1866 three juniors in mechanics. In 1868 one senior in physics, and seven juniors in mechanics. In 1869 five juniors in mechanics. In 1870 three seniors and one junior in chemistry; and in the same year two boys matriculated at the London University. I may be allowed to remark, that we are prevented from using the Oxford local examination as an efficient test of our scientific work by the rule which limits junior candidates to five subjects. It is notorious that both classics and mathematics gain many more marks in this examination than science, and thus many of our boys each year who could pass with ease in mechanics are prevented from taking the subject in.

Passing from the technical to the general results of our five years' science teaching, I can speak with very great satisfaction. It has turned many dunces into promising hopeful happy workers, and it gives to the abler boys precision of thought, the habit of accurate reasoning, and an inexhaustible fund of resource. Nor must I let it be supposed that in teaching science we undervalue the old-fashioned subjects. By improved methods and a carefully arranged time table we find room for both; and though my senior boys forego the elegant imbecilities of Latin verse composition, they write a good Latin prose, and construe Sophocles as well as the senior boys of my own time at Winchester.

The difficulty of obtaining teaching power in scientific subjects is one which will no doubt press itself on the attention of the Commissioners. There are, as yet, very few men in England whom schools, with ordinary salaries at their command, can hope to obtain. We have got over the difficulty, so far, by persuading a first-class Oxford mathematician, with fair scientific knowledge, to spend a twelvemonth at King's College. He now takes the mechanics and the chemistry, while the junior boys, the botany, and the physiology, fall to me. But I believe that before science can be taught properly in first-grade schools, a race of scientific teachers must be called into existence.

In the course of the present year we have removed from the confined and uncomfortable premises of the ancient Grammar School to a splendid building outside Taunton, with every facility for extension and development. The architect's plans include a laboratory, museum, and scientific class rooms, and of the ground attached to the school two acres have been given to me for a botanic garden. The latter will cost 100*l.*, the former more than 1,000*l.*; in the meantime we are making shift, not unsatisfactorily, with temporary rooms. One great want at the present moment is a transit instrument, which, with clock and case, I know how to obtain for 50*l.* But though in a stately building like that which we now inhabit, our wants are necessarily more or less magnificent, I may be permitted to lay great stress upon the cheapness with which, under humbler circumstances, efficient systematic science teaching can be organised. 5*l.* will buy a set of mechanical models; 16*l.* will fit up a rough laboratory for 16 boys. The cost of solutions and apparatus will be under 5*s.* per annum to each pupil, and this is really all that is absolutely necessary.

I take the liberty of enclosing with this report—

1. Two short pamphlets which express my own views and experience more in detail.
2. A set of papers illustrating our botanical teaching.
3. A prospectus of the school.

I am, Sir,
Your faithful servant,
W. Tuckwell.

To the Secretary of the Commission on
Scientific Instruction and the Advancement of Science.

BOTANICAL TEACHING AT TAUNTON COLLEGE SCHOOL.

Natural Orders.

Class I. Dicotyledones.

Division I. Polypetalæ.

Sub-div. I. Thalamifloræ.

Order 1. Ranunculaceæ.
Magnoliaceæ.
,, 2. Berberideæ.
,, 3. Nymphæaceæ.
,, 4. Papaveraceæ.
,, 5. Fumariaceæ.
,, 6. Cruciferæ.
,, 7. Resedaceæ.
,, 8. Cistineæ.
,, 9. Violaceæ.
,, 10. Frankeniaceæ.
,, 11. Caryophylleæ.
,, 12. Portulaceæ.
,, 13. Paronychieæ.
,, 14. Tamariscineæ.
,, 15. Polygaleæ.
,, 16. Elatineæ.
,, 17. Hypericineæ.
Aurantiaceæ.
Camelliaceæ.
,, 18. Malvaceæ.
,, 19. Tiliaceæ.
Byttneriaceæ.
Elæocarpæ.
,, 20. Lineæ.
,, 21. Geraniaceæ.
Tropæolaceæ.
Rutaceæ.
,, 22. Ilicineæ.
,, 23. Empetraceæ.

Sub-div. II. Calycifloræ.

Order 1. Celastrineæ.
,, 2. Rhamneæ.
Terebinthaceæ.
,, 3. Sapindaceæ.
Hippocastaneæ.
Ampelideæ.
,, 4. Leguminosæ.
,, 5. Rosaceæ.
Granateæ.
,, 6. Saxifrageæ.
,, 7. Crassulaceæ.
Ficoideæ.
Cactaceæ.
,, 8. Droseraceæ.
,, 9. Lythraceæ.
Myrtaceæ.
,, 10. Halorageæ.
,, 11. Onagraceæ.
Philadelphiæ.
,, 12. Cucurbitaceæ.
Passifloræ.
,, 13. Umbelliferæ.
,, 14. Araliaceæ.
,, 12. Cornaceæ.

Div. II. Monopetalæ.

Order 1. Caprifoliaceæ.
,, 2. Rubiaceæ.
,, 3. Valerianeæ.
,, 4. Dipsaceæ.
,, 5. Compositæ.
,, 6(a.) Lobeliaceæ.
,, 6(b). Campanulaceæ.
,, 7. Ericaceæ.
Epacridæ.
,, 8. Oleineæ.
Jasminaceæ.
,, 9. Apocyneæ.
Asclepiadæ.
,, 10. Gentianeæ.
Bignoniaceæ.
Cobæaceæ.
,, 11. Polemoniaceæ.
,, 12. Convolvulaceæ.
,, 13. Boragineæ.
Hydrophylleæ.
,, 14. Solaneæ.
,, 15. Plantagineæ.
,, 16. Scrophularineæ.
,, 17. Orobancheæ.
,, 18. Labiatæ.
,, 19. Verbenaceæ.
Acanthaceæ.
,, 20. Lentibularineæ.
Ebenaceæ.
,, 21. Primulaceæ.
Strychneæ.
,, 22. Plumbagineæ.

Div. III. Apetalæ.

Order 1. Polygoneæ.
Nyctagineæ.
Begoniaceæ.
,, 2. Amaranthaceæ.
,, 3. Chenopodiaceæ.
Laurineæ.
Myristiceæ.
,, 4. Urticeæ.
,, 5. Cannabineæ.
,, 6. Ulmaceæ.
Piperaceæ.
Juglandaceæ.
,, 7. Thymeleæ.
,, 8. Elæagneæ.
,, 9. Loranthaceæ.
,, 10. Santalaceæ.
,, 11. Aristolochieæ.
,, 12. Euphorbiaceæ.
,, 13. Ceratophylleæ.
,, 14. Salicineæ.
,, 15. Cupuliferæ.
Platanaceæ.
Garryaceæ.
,, 16. Betulaceæ.
,, 17. Myricaceæ.
,, 18. Coniferæ.
Cycadeæ.

Class II. Monocotyledones.

Div. I. Petaloideæ.

Order 1. Hydrocharideæ.
,, 2. Orchideæ.
Scitamineæ.
Canneæ.
Musaceæ.
,, 3. Irideæ.
,, 4. Amaryllideæ.
Melanthaceæ.
Bromeliaceæ.
Commelineæ.
Palmeæ.
,, 5. Dioscoreæ.
,, 6. Alismaceæ.
,, 7. Naiadeæ.
,, 8. Liliaceæ.
,, 9. Junceæ.
,, 10. Aroideæ.
,, 11. Lemnaceæ.
,, 12. Typhaceæ.
,, 13. Eriocauloneæ.

Div. II. Glumaceæ.

Order 1. Cyperaceæ.
,, 2. Gramineæ.

Class III. Acotyledones.

Div. I. Vasculares.

Order 1. Filices.
,, 2. Lycopodiaceæ.
,, 3. Marsileaceæ.
,, 4. Equisetaceæ.

Div. II. Cellulares.

Order 1. Musci.
,, 2. Characeæ?
,, 3. Hepaticæ.
,, 4. Lichenes.
,, 5. Fungi.
,, 6. Algæ.

The numbered Orders are British. Those printed in Italics are Exotic, but contain plants commonly cultivated in England or possesing special interest.

SCHEDULE.

ORGANS.	COHESION SUPPRESSION.	ADHESION INSERTION.
Calyx, *sepals.*	*Asepalous* *Polysepalous* *Gamosepalous*	*Superior* *Inferior*
Corolla, *petals.*	*Apetalous* *Polypetalous* *Gamopetalous*	*Hypogynous* *Perigynous* *Epigynous*
Perianth, *leaves.*	*Polyphyllous* *Gamophyllous*	*Hypogynous* *Perigynous* *Epigynous*
Stamens, *filaments,* *anthers.*	——*androus* ——*adelphous* ——*dynamous* *Syngenesious*	*Hypogynous* *Perigynous* *Epigynous* *Epipetalous* *Gynandrous*
Pistil, *carpels.*	*Syncarpous* *Apocarpous*	*Superior* *Inferior*

Class__________ Order__________

Division__________ Genus__________

Sub-division__________ Species__________

LEAF.	
Position -	*Radical.* *Cauline.*
Insertion -	*Sessile.* *Stalked.*
Arrangement -	*Alternate.* *Opposite.* *Whorled.* *Decussate.*
Composition -	*Simple.* *Compound.*
Shape -	*Roundish, Ovate.* *Obovate, Oval.* *Lanceolate, Linear.* *Subulate, Cordate.* *Sagittate, Hastate.* *Ternate, Pinnate.* *Digitate, Palmate.* *Pedate, Reniform.*
Margin -	*Entire, Serrate.* *Dentate, Crenate.*
Stipulation -	*Stipulate, Ex-stipulate.*
INFLORESCENCE -	*Spike, Raceme.* *Panicle, Corymb.* *Cyme, Umbel, Head.*
BRACTEATION -	*Bracteate, Ebracteate.*

BLANK SCHEDULE.

ORGANS.	NO.	COHESION SUPPRESSION.	ADHESION INSERTION.
Calyx, *sepals.*			
Corolla, *petals.*			
Perianth, *leaves.*			
Stamens, *filaments,* *anthers.*			
Pistil, *carpels.*			

Class__________ Order__________

Division__________ Genus__________

Sub-division__________ Species__________

LEAF.

Position.
Insertion.
Arrangement.
Composition.
Shape.
Margin.
Stipulation.

INFLORESCENCE.

BRACTEATION.

Filled up by

Date

---

7. ROSSALL SCHOOL.

To Her Majesty's Commission on Scientific Instruction and the Advancement of Science.

MY LORDS,

I AM honoured with your Lordships' instructions to present a statement showing to what extent scientific instruction has been introduced into Rossall School, and how many pupils have availed themselves of it, and with what effect, in each year since its introduction.

Natural Science has been taught at this school with varying and uncertified results for some years past. With the commencement of this present year, and upon the appointment of a new Head Master, it has taken a prominent position in the general curriculum. A regular science master was appointed (a distinguished young Oxford man, Mr. Herbert Tomlinson, Junior Student of Christ Church, Whitworth (Oxford) Exhibitioner, F.R.A.S.), and about 100*l*. per annum allowed for chemicals, apparatus, &c.

There is a large lecture room, capable of accommodating

50 boys at a time with ease, and well furnished with laboratory, &c., and all requirements for illustrating lectures on mechanics, heat, magnetism, electricity, pneumatics, and chemistry. In last Christmas Report of the School, it was stated that "Natural Science would henceforth be taught "to the whole of the Modern School and to volunteers from "the Classical" (charge one guinea a year). The whole school at present numbers 302; the modern side, 58; and, with the exception of the preparatory (30), and lower school (35), the classical side have almost universally volunteered to study natural sceince. The classical side at present only attend one hour per week, and the modern side two hours. This last, however, the head master hopes to see re-arranged to the still further promotion of the sciences. Besides this general teaching, however, our energetic natural science master has organized a special class to meet the requirements of boys reading the higher subjects and desirous of working experiments. The boys evidently take great interest in their work, and many of them are making considerable progress. We have a small observatory with a good equatorial, and lectures on astronomy are being given to the highest form, classical and modern, and volunteers are taught how to use the instruments and make observations. Of this last class the number is about 12. In connexion with Natural Science, and in the direction pointed out by the Whitworth Exhibitions (of which one was put at the disposal of the head master), carpenters' workshops have been fitted up, and benches and tools provided for as many as seven at a time (charge, including use of tools, 5*s.* per quarter). In extension of this branch of education, the head master is particularly anxious (when funds admit) to add lathes, one or more, and a stone polishing machine, and a forge. Arrangements have been made for setting up a complete system of meteorological observations.

Your Lordships will, perhaps, allow me here to express one or two convictions that have become imprinted on my mind in this matter. First, I feel strongly that boyhood is essentially the age of observation and love of nature. A boy's quick eye for a bird's nest has always struck me as a valuable power that ought to be educated. It is the same with mushrooms, trees likely to supply walking canes, objects of interest on the seashore, &c., &c. Stones, shells, fossils, skeletons, may be had in any number from the boys at the least sign of encouragement. Firm believer as I am, myself, in Latin and Greek for cultivating the higher powers of the human mind, memory and judgment, I am still ready to admit that to exclude Natural Science as a study, is to leave untrained the third in rank, perhaps, but the first in development, of our powers—observation. Lastly in Lancashire I find there is a strong demand for common-sense philosophy; and I so far sympathize with the sentiment as to feel that, whether capable of the profundities of metaphysics and mathematics or not, no one would be the worse for knowing the difference between a "hawk and a handsaw."

I have the honour to be, my lords,
Your lordships' faithful servant,
ROBERT HENNIKER, M.A.,
Head Master.

Rossall, 15th September 1870.

---

8. THE CITY OF LONDON SCHOOL.

City of London School, E.C.
16th Septr. 1870.

SIR,

I WAS requested last July to furnish you with a report on the scientific instruction given at the City of London School, and I was asked to state the subjects and number of pupils taught, the times of study, and the results of the study each year. As the request arrived during our examinations, and just before the conclusion of the term, it was impossible to draw up the statement immediately. But I requested Mr. Durham, our lecturer, to compile the requisite information with as little delay as possible. This he has done. I have inspected his report, to the general accuracy of which I can certify, and I now have the pleasure of forwarding it to you.

I am, Sir,
Your obedient servant,
EDWIN A. ABBOTT.

J. Norman Lockyer, Esq.,
6, Old Palace Yard, S.W.

City of London School,
19th Septr. 1870.

SIR,

IN your communication of the 23rd July you requested that I would furnish you with a statement showing (1) To what extent scientific instruction had been introduced at the City of London School. (2.) How many pupils have availed themselves of it; and (3.) With what effect, in each year, since its introduction.

1. To enable you to form some idea of the extent of the scientific instruction introduced at the City of London School, I will give a list of the subjects taught in each division, of which there are six.

The 1st division being formed of the 6th and 5th forms.
„ 2nd division „ 4th and Latin classes.
„ 3rd division „ 3rd and 2nd classes.
„ 4th division „ 1st and grammar classes.
„ 5th division „ 1st jun. and 2nd jun. classes.
„ 6th division „ 3rd jun. and 4th jun. classes.

Each division has one lecture a week.

SUBJECTS TAUGHT.

6th Division, A.

A
(*a.*) Atomic theory.
(*b.*) Hydrogen, oxygen, nitrogen, and the compounds formed by their union.
Physical and chemical properties of water.
Do. „ „ air.
(*c.*) Thermometers, barometers, air pump, &c.
(*d.*) Ventilation.
(*e.*) Use of aqua fortis as a chemical test (especial attention to).

5th Division, B.

B
(*a.*) Subjects mentioned under A.
(*b.*) Carbon and its compounds with oxygen and hydrogen (inorganic compounds) and coal gas.
(*c.*) Blowpipe, nature of flame, conduction and convection of heat.
(*d.*) Davy lamp.

4th Division, C.

C
(*a.*) Subjects under cap. A. & B.
(*b.*) Sulphur, Phosphorus } and their compounds with O & H.
Chlorine, Bromine, Iodine } especial attention to their uses as re-agents.
Fluorine, hydric fluoride, hydric hydrofluosilicate.
(*c.*) Special attention is given to the manufacture of oil of vitriol, and muriatic acid.

3rd Division, D.

D
(*a.*) Subjects given under cap. A. B. & C.
(*b.*) The common metals (especial attention being given to the metallurgical processes for obtaining iron, copper, lead, zinc, silver, mercury, tin, and gold).
(*c.*) Manufacture of steel.
Tempering steel.
(*d*) Manufacture of pigments (common).

2nd Division, E.

E
(*a.*) Subjects given in A. B. C. & D.
(*b.*) Manufacture of pigments.
(*c.*) Alkalies and alkaline earths.
(*d.*) Heat.
(*e.*) Frictional and voltaic electricity { especial attention to electric telegraphy.
(*f.*) Magnetism.
(*g.*) Outline of theoretical chemical analysis.
(*h.*) Outline of physical geography (slight).

1st Division.

(*a.*) Organic chemistry (special attention is given to fermentation, and the manufacture of soaps, candles, dyes, &c.).
(*b.*) Higher branches of experimental physics and inorganic chemistry.

In addition to the lectures, a class was formed (28th October 1868) for the study of practical chemistry (principally preliminary examination by the blowpipe): the three best boys in each of the nine head classes (viz. 6th form to 1st junior class, inclusive) are allowed to join this class.

During the last term, however, 34 boys were permitted to avail themselves of this privilege.

Those who have a decided taste for the study of science are prepared in all its branches.

(2.) To what extent have the pupils availed themselves, &c.?

Scientific instruction (chemistry and experimental physics) was first introduced as an optional study at Easter, 1847. Towards the close of the year 1860, the study of science was made compulsory.

The number of boys who availed themselves of it while an optional study is shown by the following table, viz :—

In July 1847	158	In July, 1854	123
„ 1848	130	„ 1855	137
„ 1849	176	„ 1856	156
„ 1850	157	„ 1857	182
„ 1851	164	„ 1858	188
„ 1852	161	„ 1859	167
„ 1853	137	„ 1860	178

And the subjoined list will give the average number of boys in the City of London School from 1861–1870 inclusive :—

In 1861	630	In 1866	649
„ 1862	628	„ 1867	651
„ 1863	622	„ 1868	654
„ 1864	637	„ 1869	657
„ 1865	633	„ 1870	654

(3.) And with what effect in each year since, &c. ?

To show with what success the instruction in science (previous to 1860) has been attended, I will name a few of the pupils who have highly distinguished themselves, and who left the City of London School previous to this date, viz., 1860.

Edward Divers, M.D. -	(Lecturer on Medical Jurisprudence at Middlesex Hospital.)
Prof. Unwin, C.E.B.Sc.	(Examiner in Mechanical and Machine Drawing, R.S.M.)
Prof. Bloxam, F.C.S. -	(Lecturer on Natural Science, Cheltenham College.)
Prof. Heaton, F.C.S. -	(Late Charing Cross Hospital) Lecturer on Chemistry and Natural Philosophy (Epsom College).
Wm. Hy. Perkins, F.R.S., F.C.S.,	Honorary Secretary to the Chemical Society.
John Spiller, F.C.S. -	(Late Assistant Chemist to War Department, Woolwich,) Honorary Secretary to the Photographic Society.
H. Matthews, F.C.S.	
Wm. Spiller, F.C.S.	
J. A. Aldis, M.A., &c.	

The first public examination in chemistry in connexion with South Kensington was held in 1860, and we obtained one 1st and two 2nd class prizes.

I am afraid we cannot give you a complete list of honours for this year (1860), as I am obliged to trust to my memory, for no account of science successes gained previous to 1861 has been kept by us. In this difficulty, I applied to the secretary, Science and Art Department, who deputed Mr. McLeod to state that to give the information I required would involve very considerable research, and to express his regret that the Department had not the means of instituting it. If, however, I should learn any further details I will forward them to you.

I will now, as briefly as possible, give you a list of the honours, distinctions, &c., gained by the City of London School during the last 10 years.

In 1861 :

The school obtained at South Kensington
1 gold medal for experimental physics.
1 „ „ mechanical physics.
1 bronze „ experimental physics.

In 1862 :

At South Kensington we obtained—
7 1st class prizes in experimental physics.
3 1st class „ chemistry.
2 2nd class „ „
1 2nd class „ experimental physics.
1 2nd class „ mechanical physics.
1 3rd class „ chemistry.

And at the Royal School of Mines we obtained the 2nd prize in 1st class in physics, and a 1st class in chemistry.

In 1863 :

We obtained at Magdalen College, Oxford, the open Natural Science exhibition, and at the Royal School of Mines we had

2 in 1st class in experimental physics.
1 in 1st class in chemistry, and
1 in the 2nd class in chemistry.

At South Kensington this school obtained :

2 royal exhibitions for physical science ; also
1 gold medal for experimental physics.
1 „ „ mechanical physics.
silver medals for experimental physics.
1 bronze „ „ „ and
3 1st class Queen's prizes in inorganic chemistry.
1 „ „ „ organic chemistry.
1 „ „ „ mechanical physics.
4 „ „ „ acoustics, light and heat.
1 „ „ „ magnetism and electricity
3 2nd class „ „ „ „
2 „ „ „ inorganic chemistry.
1 „ „ „ acoustics, light and heat.
6 3rd class „ „ inorganic chemistry.
1 „ „ „ magnetism and electricity, and
7 honourable mention in inorganic chemistry.

In 1864 :

At the University of London—
1 passed in honours, in chemistry and natural philosophy, in preliminary scientific examination for degree of M.B.
1 was placed in honours in chemistry at the matriculation examination.
1 obtained honours in zoology and the university prize at the matriculation examination.
1 passed in honours in chemistry at the matriculation examination.

At the Royal School of Mines—
1 obtained 2nd place in 1st class in mineralogy for 2nd year students.
1 do. for geology in do.
4 were placed in 1st class in chemistry for 1st year students.
1 placed in do. in physics for do.
1 do. in 2nd class in chemistry for do.
1 do. in 3rd class in physics for do.

And at South Kensington were gained—
1 silver medal for acoustics, light, and heat.
1 bronze „ do.
1 do. theoretical mechanics ; also
4 1st class Queen's prize in inorganic chemisty.
3 „ „ „ organic chemistry.
2 „ „ „ magnetism and electricity.
1 1st class Queen's prize in acoustics, light, and heat.
2 „ „ „ theoretical mechanics.
1 „ „ „ vegetable physiology and economic botany.
1 „ „ „ animal physiology.
1 „ „ „ physical geography.
1 „ „ „ geology.
4 2nd class „ „ inorganic chemistry.
3 „ „ „ acoustics, light and heat.
1 „ „ „ magnetism and electricity.
1 „ „ „ vegetable physiology and economic botany.
1 „ „ „ animal physiology.
1 „ „ „ physical geography.
1 „ „ „ mathematics.
1 „ „ „ metallurgy.
17 3d class „ „ inorganic chemistry.
1 „ „ „ acoustics, light and heat.
1 „ „ „ applied mechanics.
1 „ „ „ zoology.
1 „ „ „ physical geography.
1 „ „ „ mathematics.
1 „ „ „ geology.
1 „ „ „ marine steam.
1 „ „ „ practical plane and descriptive geometry.
6 Honourable mention in inorganic chemistry.
2 „ „ „ magnetism and electricity.
1 „ „ „ geology.
1 „ „ „ marine steam.
1 „ „ „ mineralogy.

In 1865 :

At the University of London—

One passed in the first B. Sc. examination, and at University College, London—

We obtained the gold medal for analytical chemistry, and the silver medal for theoretical chemistry. In the examinations at the

Royal School of Mines, London—

1 received the Royal exhibition of 25*l*. (for 2nd year students) for mineralogy and geology.
Passed the examination for the 3rd year, viz.: those in natural history and palæontology in the first class. Received the Edward Forbes medal and prize of books to the value of 8 guineas for natural history and palæontology, being first in a special examination in those subjects, and received the title of "Associate of the Royal School of Mines."
And in the examination for first year students we obtained the 1st year's prize of 15*l*. for proficiency in physics. We had likewise.

2 placed in the 1st class in physics.
2 „ „ „ chemistry.
1 „ „ „ practical chemistry.
1 „ „ 2nd „ mineralogy.
1 „ „ „ geology.

At South Kensington we gained—

1 bronze medal for proficiency in geology.
Also 1 silver „ applied mechanics.
1 bronze „ inorganic chemistry.
1 „ „ organic chemistry.
And 2 Queen's exhibitions, 50*l*. for 3 years and free instruction at Government School of Science, Dublin. Also
3 placed in the 1st class in inorganic chemistry.
2 „ „ „ organic chemistry.
3 „ „ „ magnetism & electricity.
1 „ „ „ applied mechanics.
2 „ „ „ animal physiology.
6 „ „ 2nd „ inorganic chemistry.
3 „ „ „ magnetism & electricity.
1 „ „ „ theoretical mechanics.
1 „ „ „ animal physiology.
2 „ „ „ physical geography.
1 „ „ „ steam.
1 „ „ „ geology.
10 „ „ 3rd „ inorganic chemistry.
2 „ „ „ acoustics, light, and heat.
4 „ „ „ magnetism and electricity.
1 „ „ „ theoretical mechanics
2 „ „ „ vegetable physiology and economic botany.
1 „ „ „ steam.
1 „ „ „ mineralogy.
1 „ „ „ geology.
1 „ „ „ mechanical and machine drawing.
1 „ „ „ mining.
16 „ „ 4th „ inorganic chemistry.
3 „ „ „ acoustics, light, and heat.
1 „ „ „ theoretical mechanics.
1 „ „ „ vegetable physiology.
2 „ „ „ zoology.
1 „ „ „ steam.
1 „ „ „ mechanical and machine drawing.
1 „ „ „ building construction.

In 1866:

1 of the old pupils was elected a Fellow of the Royal Society, and
2 were elected Fellows of the Chemical Society.

At the University of London—

1 in the examination for the degree of B.Sc. obtained 3rd class honours in chemistry and 2nd class honours in geology and palæontology, and degree of Bachelor of Science; while
1 in the preliminary scientific examination for M.B. passed in the 1st class in honours in chemistry and natural philosophy.

At the Oxford Senior Local Examination—

1 passed with 2nd class honours in chemistry and physics.

At the Royal School of Mines, London—

1 was passed in the 1st class in physics.
2 were „ „ 2nd „ do.
1 was „ „ „ „ chemistry.
1 „ „ „ „ geology.
1 „ „ „ „ mechanical drawing.

At the Government School of Science, Dublin, we obtained the

1st prize in practical chemistry.
1st „ magnetism and electricity.
1st „ geology.
2nd „ theoretical chemistry.
2nd „ natural philosophy.
3rd „ geology.

At King's College, London (evening classes), we gained a prize in experimental physics and a certificate in zoology.

At South Kensington—

A Royal exhibition of 50*l*. for three years, with free education at the Royal School of Mines and Royal College of Chemistry; also

3 1st class prizes in inorganic chemistry.
3 „ „ acoustics, light and heat.
1 „ „ magnetism and electricity.
1 „ „ theoretical mechanics.
1 „ „ applied mechanics.
1 „ „ zoology.
1 „ „ physical geography.
2 2nd „ „ inorganic chemistry.
4 „ „ magnetism and electricity.
1 „ „ vegetable physiology.
1 „ „ physical geography.
2 „ „ elementary mathematics.
1 „ „ geology.
22 3rd „ „ inorganic chemistry.
2 „ „ geometry, and
1 „ in each of the following subjects:—

Acoustics, light and heat.
Theoretical mechanics
Applied mechanics.
Animal physiology.
Physical geography.
Elementary mathematics
Steam.
Metallurgy.

15 were placed in the 4th class in inorganic chemistry
2 „ „ „ organic chemistry, and
1 was „ „ „ acoustics, light and heat, magnetism and electricity, and navigation.
16 obtained a 5th class in inorganic chemistry, and
1 „ „ systematic botany.
1 „ „ mining.

In 1867:

1 was appointed to be demonstrator of chemistry at King's College, London.
1 to be senior-assistant chemist to the Rivers Commission.
1 to be assistant chemist to the War Department, Woolwich, and
1 was selected to be educated at the expense of the Government for ultimate employment in the higher branches of the Department for the conservation of the forests under Government in India.

At the University of London—

1 gained the 1st place in M.B. examination with 2nd class honours in physiology and 3rd class honours in chemistry, also degree of B.Sc. with 1st class honours in zoology and 2nd class honours in botany.

At the Royal School of Mines —

1 was awarded the 1st of two scholarships of 15*l*. for 1st year students, and placed 1st in physics and mathematical drawing, and 1st in chemistry; and we gained
1 1st class in geology.
1 was placed 1st in 2nd class in chemistry.
1 was placed in the 2nd class in mineralogy.
1 passed in chemistry.
1 „ mineralogy.
1 „ mechanical drawing, and

At the Government School of Science, Dublin, we obtained the

1st prize in physics.
1st „ zoology.
1st „ magnetism, electricity, and galvanism.
2nd „ acoustics, light and heat.
2nd „ mechanics.

At the Pharmaceutical Society—

A junior Jacob Bell memorial scholarship, 30*l*., with free instruction in the laboratory of the society for 1 year.

South Kensington—

Royal exhibitions of 50*l*. per annum for 3 years, with free education at the R.S.M. and R.C.C. London; and
1 gold medal in theoretical mechanics.
1 silver ,, for mechanical physics.
1 ,, ,, ,, magnetism and electricity.
1 ,, ,, ,, inorganic chemistry.
1 ,, ,, ,, acoustics, light and heat.
1 bronze ,, ,, applied mechanics.
1 ,, ,, ,, magnetism and electricity.
1 ,, ,, ,, animal physiology.
1 ,, ,, ,, inorganic chemistry.
1 ,, ,, ,, organic chemistry; also
6 1st class prizes in inorganic chemistry.
2 ,, ,, organic do.
2 ,, ,, acoustics, light, and heat.
5 ,, ,, magnetism and electricity.
2 ,, ,, animal physiology; and
1 ,, prize for each of the following: theoretical mechanics; applied mechanics; zoology; physical geography; elementary mathematics; practical, plane, and descriptive geometry; mineralogy; geology; and building construction.
4 2nd class prizes in inorganic chemistry.
3 ,, ,, organic chemistry.
2 ,, ,, magnetism and electricity.
2 ,, ,, mechanical and machine drawing, and
1 ,, ,, in each of the following:—applied mechanics, animal physiology, zoology, physical geography, steam, metallurgy, geology, mining, building construction, and navigation.
4 3rd class prizes in inorganic chemistry.
2 ,, ,, organic chemistry.
4 ,, ,, acoustics, light, and heat.
2 ,, ,, vegetable physiology.
4 ,, ,, physical geography. And
1 3rd class prize in each of the following:—Magnetism and electricity, theoretical mechanics, practical, plane, and descriptive geometry, metallurgy, mining, building construction, navigation, and higher mathematics.
1 4th class in each of the following:—Magnetism and electricity, applied mechanics, physical geography, steam, metallurgy, mineralogy, nautical astronomy.
2 5th class certificates in acoustics, light, and heat.
3 ,, ,, theoretical mechanics.
2 ,, ,, applied mechanics, and
1 ,, ,, nautical astronomy, geology, magnetism and electricity.

In 1868:

1 was appointed assistant chemist to the Royal Institution of Great Britain, and
1 was appointed chief private assistant to Professor Frankland, F.R.S., of the Royal School of Mines and Royal College of Chemistry.

At the University of London—

1 in the 2nd B.A. examination passed with 3d class honours in animal physiology.
1 in the 1st B.Sc. examination obtained honours in biology.
1 in the 1st B.C. examination obtained honours in chemistry.
1 in the 1st B.C. examination obtained honours in natural philosophy. And
1 obtained the Whitworth exhibition for mechanical science, value 25*l*. for one year.

At the Royal School of Mines—

1 obtained title of Royal School of Mines, and 1st class in metallurgy; 1st class in applied mechanics for 3rd year students.
1 obtained the Directors' Medal and Prize of Books (25*l*.); 1st class in mechanical drawing; 1st geology; 2nd mineralogy for 2nd year students, and for the 1st year students—
1 obtained Royal scholarship of 15*l*.
2 were placed in 1st class in chemistry.
2 ,, ,, physics.
1 ,, ,, mechanical drawing.
1 was placed in 2nd class in ,, and
2 were placed in ,, chemistry.

At the Government School of Science, Dublin—

The 1st prize in practical chemistry
,, 1st ,, manufactures
,, 2nd ,, comparative anatomy were gained.

King's College, London (evening classes).

To one was awarded the 1st prize in zoology, 2nd prize in geology, 2nd prize in chemistry, and admitted Associate of King's College, London.

At South Kensington was gained

A Royal exhibition 50*l*. per annum for three years, with free education at R.S.M. and R.C.C., London; also one bronze medal for proficiency in organic chemistry.
1 bronze medal for proficiency in metallurgy, and
3 1st class Queen's prizes in inorganic chemistry.
1 ,, ,, ,, organistic chemistry, acoustics, light and heat, magnetism and electricity, and metallurgy.
4 2nd class Queen's prizes in inorganic chemistry.
2 ,, ,, ,, organic chemistry.
3 ,, ,, ,, magnetism and electricity.
2 ,, ,, ,, animal physiology.
1 ,, ,, ,, in each of the following: acoustics, light and heat, zoology, systematic botany, and metallurgy.
2 3rd class prizes in acoustics, light and heat.
2 ,, ,, vegetable physiology.
1 3rd class prizes in each of the following:—inorganic chemistry, applied mechanics, mechanics, zoology, steam, metallurgy and geology.
2 4th class in mineralogy; while
1 5th class certificate was obtained in each of the following:—theoretical mechanics, applied mechanics, vegetable physiology, animal physiology, steam, and metallurgy.

In 1869:

was appointed honorary secretary to the Chemical Society.
1 was appointed honorary secretary to the Photographic Society.
1 was appointed professor of chemistry and natural philosophy at Epsom College.
1 was appointed assayer to the Walaroo Mining Company, South Australia.
1 was appointed Fellow of the Chemical Society.
1 ,, ,, Geographical Society.
2 were appointed assistant chemists to the Royal College of Chemistry.
1 was appointed assistant chemist to the London Hospital.
1 was appointed to St. Thomas's Hospital.

St. John's College, Cambridge:

1 gained the open scholarship for natural science (50*l*. a year), and

At the University of London—

1 in the 1st B.Sc. examination and preliminary M.B. examination was placed—
1st in the 1st class in botany, and gained an exhibition of 40*l*. for two years, and
1st in the 1st class in zoology, and gained an exhibition of 40*l*. for two years.

1 obtained the degree of M.B., with
1st class honours in medicine, and
2d „ „ midwifery; also the Degree of B.S. (Bachelor of Surgery), with 1st place in 1st class honours (and gold medal) in surgery, with an university scholarship of 50*l*. a year for two years.
1 in the 1st B.Sc. examination gained honours in chemistry and natural philosophy.
1 passed in 2nd division in 1st B.S., and preliminary scientific M.B.
1 obtained 2nd class honours in zoology in do. do.

At the Society of Apothecaries—
1 obtained the 1st place and gold medal in a competitive examination of medical students for prizes in botany, annually given by this society.

At the Royal School of Mines—
To 1 was awarded the title of Associate of the Royal School of Mines in mining and metallurgical divisions, he having gained a 1st class in mining and ditto in applied mechanics for third year students.
Another took the Duke of Cornwall's scholarship's 30*l*. for two years, he having been placed
2nd in 1st class in mining.
2nd in 1st „ geology, and
„ 1st class in mechanical drawing for second year students.
A third obtained the 1st of two Royal exhibitions of 15*l*. for 1st year students, and was placed
1st in 1st class in chemistry.
2nd „ „ experimental physics.
1st in 2nd class in mechanical drawing.
A fourth was placed in the 1st class in chemistry for 1st year students.

At King's College, London (evening classes)—
A special certificate in practical chemistry.
„ „ „ anatomy
„ „ chemistry.
„ „ medicine.
„ „ forensic medicine and botany.
A certificate of honour in materia medica.
„ „ „ clinical surgery, and the Todd medal and prize of books for chemical medicine.

At South Kensington—
2 obtained 1st class in honours in magnetism and electricity.
1 „ „ „ inorganic chemistry.
1 „ „ „ acoustics, light and heat.

We gained—
1 2nd class in honours in each of the following:—acoustics, light and heat, magnetism and electricity, and elementary mathematics. Also
1 1st class advanced stage in each of the following:—Magnetism and electricity, elementary mathematics, applied mechanics, and organic chemistry.
4 2nd class advanced stage in theoretical mechanics.
3 „ „ „ elementary mathematics.
2 „ „ „ organic chemistry.
2 „ „ „ navigation; and
1 „ „ „ each of the following:—zoology, higher mathematics, acoustics, light and heat, vegetable anatomy and physiology, and metallurgy.
1 1st class elementary stage in metallurgy, physical geography, and inorganic chemistry.
3 2nd class elementary stage in inorganic chemistry,
1 „ „ „ geology, building construction, physical geography, and magnetism and electricity.
5 3rd class elementary stage in inorganic chemistry.
2 „ „ „ mineralogy.
2 „ „ „ practical, plane, and descriptive geometry; and
1 „ „ „ systematic botany, mechanical and machine drawing, and physical geography.

In 1870:
1 was appointed lecturer on medical jurisprudence at the Middlesex Hospital.
1 „ professional examiner in mechanical and machine drawing for the R.S.M and S.K.
1 „ assistant examiner in chemistry to South Kensington (for the current year).
2 were appointed gas examiners; 1 under corporation, London,
1 for Dalston district.
1 was appointed chemical superintendent of the Schültz Gunpowder Works, Hants.
1 „ assistant to Dr. Thudichum (Lecturer on Pathological Chemistry St. Thomas's Hospital).

At the University of Cambridge—
A natural science scholarship at St. John's College

At the University of London—
1 degree of B.Sc. in 2nd division.
1 in 1st B.Sc. in honours examination, 1st class in chemistry and 1st class in natural philosophy.

At the Royal School of Mines—
1 has gained the title of Ass. R.S.M., in natural history and palæontology, being
1st in 1st class in natural history, and 1st (only one) in 1st class in palæontology for 3rd year students.
In the examination for 2nd year students, 1 has taken the 2nd place in 1st class in mechanical and machine drawing, and
1st do. in 2nd class in mineralogy, and
„ „ geology.

At the Medical College, St. Thomas's Hospital (Winter Session).
We have obtained the 1st place in chemistry.

At the London Institution—
1 has taken the 1st class in chemistry, and
the 7th „ elementary physics.

At South Kensington—
1 1st class in honours in inorganic chemistry.
1 „ „ acoustics, light, and heat.
1 „ „ stages 4 and 5 mathematics.
1 2nd class „ practical, plane, and descriptive geometry.
1 „ „ stages 1, 2, and 3 mathematics.
1 „ „ inorganic chemistry
2 1st class advanced stage in magnetism and electricity.
1 „ „ „ each of the following:—inorganic chemistry, mechanical and machine drawing, and pure mathematics.
3 2nd class advanced stage in inorganic chemistry.
1 „ „ „ organic chemistry acoustic, light and heat, and magnetism and electricity.
6 1st class elementary stage in inorganic chemistry.
3 „ „ „ magnetism and electricity.
3 „ „ „ physical geography.
2 „ „ „ pure mathematics.
1 „ „ „ mechanical and machine drawing.
8 2nd class elementary stage in inorganic chemistry.
2 „ „ „ magnetism and electricity.
2 „ „ „ animal physiology.
2 „ „ „ physical geography.
1 „ „ „ pure mathematics and in theoretical mechanics.

HENRY DURHAM,
Lecturer on Chemistry and Experimental Physics in the City of London School.

To the Rev. E. Abbott Abbott, M.A.

have examined the above and can certify to its general accuracy.

EDWIN A. ABBOTT, M.A.,
Head Master of the City of London School.

J. Norman Lockyer, Esq.

City of London School,
Milk Street, Cheapside, E.C.
SIR, 27th September 1870.

I AM requested by the Head Master, as a supplement to my report to you on the scientific honours and distinctions gained by pupils of the City of London School, to state that the first of the five exhibitions for mechanical science (theoretical division) given by Sir Joseph Whitworth, has this year been awarded to Wm. Garnett, who left this school in July 1869 for Cambridge.

I have the honour to be, Sir,
Your obedient servant,
H. DURHAM,
Lecturer on Chemistry and Experimental Physics, &c.

J. Norman Lockyer, Esq.

---

9. CHELTENHAM COLLEGE.

To the Royal Commission on Scientific Instruction.

The College, Cheltenham,
My Lords and Gentlemen, October 22nd, 1870.

This college contains three departments—

The classical.
The military and civil.
The junior.

In the junior department, where no boy remains after 13, there is no instruction in physical science or in natural philosophy.

In both of the senior departments there is such instruction, and to show the extent to which it has been carried out, and in some degree the effect, I beg to submit to you the following statement:—

Scientific instruction in physical science was introduced, in the year 1854, into the military and civil department only, and is now given to the nine upper classes of that department, containing about 120 boys.

The subjects now taught are—

Geology,
Heat,
Chemistry and electricity.

Commencing with geology in the lowest class, and following the order above.

In the upper classes the amount of knowlege acquired is very fair, and in not a few instances considerable. It may, perhaps, be best understood by reference to the examination papers in those subjects given by the examiners in the competitive tests for admission to Woolwich.

In these, the boys have obtained from 60 to 80 per cent. of the marks assigned to the subject.

The upper classes receive instruction, by means of lectures, three times in the week, and the lower classes twice a week. Besides the lectures, the boys have to read up the subjects from text books, and those who are studying chemistry and electricity also work in the laboratory under the supervision of the science master to the military and civil department.

When physical science was first introduced in 1854, the instruction was limited to the first two classes, but was gradually extended to its present limits—the first 9 out of the 19 classes in the department.

Physical science was introduced into the classical department in 1869, and the subjects taught since that date are—

1. Botany.
2. Physical geography.
3. Heat and electricity.

Physical science is taught in the classical department at the same hours as, and, therefore, as an alternative subject with, German, and is taught twice a week in the first 7 of the 17 classes.

In the three highest classes a second physical science is also taught twice a week at the same hours as, and, therefore, as an alternative subject with, French.

Thirteen boys in the three highest classes are now receiving instruction in botany thrice a week, as well as instruction in heat and electricity twice a week, but boys in the four next classes receive instruction in one physical subject only.

For the future it is intended to teach botany to the three lowest of these seven classes, to begin heat and electricity in the fourth class, and for the benefit of the three upper classes to have two sets of lectures, either or both of which they may attend; one continuing heat and electricity, the other recurring to botany.

The number of boys now learning physical science in the classical department is 63, and they attend five different sets of lectures.

It is believed that with the limited time and limited means at our disposal, it is a wise plan to aim at securing in a classical school thorough scientific grounding in (at most) two or three physical subjects only, and it is believed that botany is the best entrance to physical science for a boy whose education is mainly linguistic, solid as far as it goes, and not superficial, but dealing mainly with the diction and idioms and literature of Latin, Greek, English, and French.

Botany has certainly been found here a successful means of cultivating the faculty of observation of nature in classical boys.

Physical geography was not a success with the lower classes, though to a very few of our best boys the physical explanation of natural phenomena proved very interesting, and probably we shall not drop it wholly from our curriculum.

Heat and electricity is the most ambitious of the physical subjects hitherto taught in the classical department, and there have always been two or three boys who show aptitude and enthusiasm for the subject, who seem able to lay a real grasp on the fundamental principles of the science, and to apply them deductively to any given examples.

Should any further information be desired by H.M. Commissioners, it will be a pleasure to me to attempt to give it.

I am, my lords and gentlemen,
Your obedient servant,
T. W. JEX-BLAKE,
Principal of the College,
Cheltenham.

---

10. CLIFTON COLLEGE.

DEAR SIR, October 23rd, 1870.

AFTER a delay, which I must beg you to excuse, and which has been owing to the unexpected pressure of other engagements, I have the honour to send you my report of our scientific work here.

I hope it may be in some degree the kind of report which was required, but if not, it will give me great pleasure to answer any questions or give any further information on the subject which I can, or to request any of my scientific masters to give more specific information, if that is required.

I have put it in the shape of a plain memorandum, but if it is proper that it should be presented in the shape of a letter addressed to your chairman, I shall be glad to have it so far altered, or I will trust to your courtesy to have the necessary alterations made.

I am your obedient servant,
The Secretary of the J. PERCIVAL.
Duke of Devonshire's
Commission.

MEMORANDUM on the SCIENTIFIC TEACHING at Clifton College.

Before the year 1867, Natural Science was taught only as an extra subject, and by lectures at which attendance was voluntary. But since the spring of that year, scientific instruction has formed part of the regular routine throughout the whole College, with the exception of the two lowest forms of our Junior School, which consist of boys from 9 to 11 years of age, and the two highest forms on the classical side, in which science is an optional subject. Through all the intermediate forms science has taken its place side by side with the traditional subjects of school instruction, and has its due influence in helping a boy's progress up the school.

As, however, the time which can be thus given to scientific study by all boys without distinction is necessarily limited, and merely sufficient to give an elementary knowledge of chemistry and physics, to which our attention has hitherto been chiefly devoted, with something of scientific training and discipline, our method has been to supplement this by other teaching, the attendance at which is optional. By means of this a select number of boys obtain a more advanced scientific education in place of a special study of other subjects, or, in some cases, in addition to the usual course of classical or other work.

Thus, every boy who has, since the year 1867, risen through the school to the fifth form, has been carefully instructed in the elements of chemistry and the chief branches of physics, each boy on the classical side having regularly attended two lectures a week, and on the modern side three.

Considering the supreme importance of the method adopted in all teaching, and the disadvantage which teachers of new subjects labour under from having no traditional or approved methods to guide them, I shall, perhaps, hardly be going beyond what is required in this memorandum if I briefly describe the method we have hitherto adopted. Every boy is required during the lecture to take notes in his note book, and afterwards to write out, at his leisure, on the opposite pages, a more detailed and careful fair copy of these notes.

The boys are also required to provide themselves with text books, if these are to be had at a reasonable price, such as Roscoe's or Gill's *Chemistry*, Orme's or Cazin's *Heat*, &c. As yet, however, one of the difficulties in the way of teaching many branches of science is the want of suitable text books.

For some time our mode of testing the boys' attention to the lectures and their understanding of them was, (1.) by examining and marking the note books, the marks so given counting towards the boys' progress up the school; (2.) by *vivâ voce* questions of the lecturer each day on the subject of the previous lecture; and (3.) by a written examination similar to that in other subjects at the end of each term. But we have now adopted a modification of this method which we find to be considerably better, as producing more effort and attention on the part of the boys. The note books are kept as before, but each boy's knowledge and grasp of the subject are also tested by a fortnightly examination on paper, in addition to the usual terminal examination. These papers are corrected and given back to the boys by the lecturer, who thus has an opportunity of going over again with his class any points which seem to have been misunderstood or imperfectly apprehended, so that no boy of ordinary intelligence or industry can fail to get a sound and clear knowledge of the subject.

I have said above that our subjects have been chiefly chemistry and physics, but I ought to have added that the younger boys (*i.e.* boys of 13 and under) have been taught, during some terms, physical geography, instead of elementary physics or chemistry, and will in future be taught elementary botany and physical geography alternately.

The voluntary study of scientific subjects to which I have alluded, as supplementing that in which all boys are obliged to share, consists of three parts:—

(1.) Work in the chemical laboratory, in which about 16 boys can practise analysis at the same time. Here boys who devote themselves more especially to science, work under the guidance and instruction of the chemical master from four to eight or ten hours a week each. The average number of boys who thus work is 20.

(2.) Lectures on physical geography and botany, or zoology, which are so arranged that any boys who wish can attend them. These have been attended by an average of about 50 boys.

(3.) Special classes of boys, who, in place of classical or other work, pursue the more advanced study of particular subjects in addition to the work above described. At present we have two such classes, containing together about 20 boys, both working at heat during the present term, one giving about eight hours a week to it, the other about four.

Such is the work which we have been endeavouring to do. The results of a three years' experience are more difficult to describe with perfect accuracy. If measured by honours gained at the universities, or elsewhere, they would be considered inadequate, as compared with what we should have to show in some other subjects, but the gauge of honours, especially in a new subject which is not the chief study of the whole school, is always imperfect and often illusory.

In our case it has happened that very few boys of ability have devoted themselves specially to scientific work, and even those few have generally made it subsidiary to their mathematical training. Thus, the best representative of our Science School, who has gone to Oxford, obtained the Mathematical Studentship at Christ Church, and was also nearly equal to the successful candidate for the Natural Science Studentship, whilst one boy has obtained a Natural Science Exhibition at Cambridge.

Some others, who seemed to have no ability at all for language or literature, have done so well in their scientific work while at school, that they may expect to gain good classes at Oxford. The only candidate whom we have sent to Woolwich from our special scientific class passed into the Academy very creditably. Of the two whom we have sent for matriculation at the London University, one passed high in honours and the other in the first class.

I mention these facts, not because I count them as of much value in themselves, but as showing that we have reason to expect good results from the system adopted. The results by which I estimate the worth of our scientific teaching are of a different kind, and much more valuable.

A few stray distinctions might easily be gained without a general system of instruction affecting the whole school; but it is by their influence on the majority of boys that the value of scientific subjects must be measured.

Considering it thus, and confining myself exclusively to what is clear to every one acquainted with our school life, I can point to the following good results as already evident:—

(1.) A new interest in their school work to many boys who before had scarcely any interest at all in it.

(2.) A consequent increase of the spirit of work throughout the school.

(3.) The general stimulus which is given to boys of a scientific turn by the opening thus afforded them, inasmuch as the marks which they obtain for excellence in scientific subjects help them to rise to a higher place in the school, and so call out more effort even in those subjects in which they do not excel, besides bringing them more into contact with boys of superior ability, and consequently shortening, in many cases, the period of idle and inert boyhood, and helping to awaken in many boys a new consciousness of their own mental powers, and the pleasure of successful mental effort, which is confessedly one of the most difficult parts of the schoolmaster's work.

(4.) A new interest pervading the school in regard to scientific subjects and pursuits, which thus become matter of talk and inquiry, working themselves into the common life of the boys, and creating a more intelligent tone.

This last result is already bearing very marked fruits in the growth of a prosperous Scientific Society, which is managed by the boys themselves and one or two of the science masters. This society holds fortnightly meetings, at which scientific papers are read and discussed, objects illustrative of natural history are exhibited and explained, and so forth. A record of its proceedings is kept by the secretaries, the first volume of which will shortly be printed. The number of boys who can belong to it is limited to 70, and the interest excited by it in the school is so considerable that there are regularly a number of boys waiting their turn for election.

We are at present engaged in the formation of a museum, which we are making of a strictly educational character, *i.e.* admitting nothing but what contributes directly to its educational value; we are also stocking a moderate sized botanical garden with typical specimens of plants, which will materially help the study of botany; and we are about to set up an apparatus for meteorological observations.

In all this our aim has been to make the boys themselves the chief agents, only advised, directed, and assisted by the science masters, and one or two scientific neighbours who take a warm interest in these matters.

Thus, our natural history master is president of the Scientific Society, and curator of the museum and botanical garden, but for everything connected with their management he has associated with him committees of the boys, made up of those most prominent in these subjects.

I have dwelt upon this voluntary and extraneous part of our scientific work, as distinct from our school teaching, because it would otherwise have been impossible to give a correct idea of the influence of science in the school; and, moreover, I attach great importance to this voluntary work, and should wish to see it encouraged and fostered in all schools.

How we are to occupy the thoughts and direct the life of boys out of school, is a question which has hitherto met with nothing like adequate attention. The variety which can be introduced into school routine has limits which are soon reached, and it is idle to suppose that we shall ever be able to educate boys in school by the mere stimulus of their own tastes. To the greater number, a considerable portion of their school lessons will always continue to be a laborious discipline. And yet our education fails if we do not succeed in developing tastes and creating intellectual activity.

If nothing is done for boys during their leisure time, the result is a great deal of idleness and vacuity. If games are organized and encouraged, and nothing else done, their results what we see so much of at present, an excessive growth of athleticism, drawing off and absorbing energies which might, in many cases, have been more profitably and with at least equal satisfaction devoted to literary or scientific pursuits. Hence the supreme importance of encouraging such pursuits as natural history, and the formation amongst boys of societies for stimulating the love of such pursuits. I have said above that a schoolmaster finds one of his greatest difficulties in dealing with ordinary boys to consist in rousing them to feel conscious of mental powers, and to be at all active in their use, so that some of our most valuable educational aids are those which foster intellectual tastes, and bring home to boys the sense of an intellectual pleasure.

For this end science seems to have great advantages over every other subject of school instruction. I know of nothing else which has so many attractions for ordinary boys, or which consequently can affect so wide an area of school life.

Scientific subjects rouse an interest in many minds which other subjects have not touched, and this I attribute in a great degree to the fact that they appeal to so many faculties and touch upon common life at so many points, that they have in them a special reality for dull and unimaginative boys.

I believe there is not a master in our school, however devoted to the study of languages or literature, who would be willing that any of our scientific work should be discontinued, or who would not be obliged to confess to the evident advantages which have already resulted from it. Yet our present results can hardly be considered as more than an intimation of what may be expected when the teaching of science has got beyond its present rudimentary stage; that is, when good text books and apparatus are more accessible, when masters thoroughly trained in approved and effective methods of teaching are less rare, and when the relations between science and other subjects have been more clearly settled.

Our supply of masters for the teaching of science has hitherto been as follows:—

(1.) One master who devotes his whole time to the teaching of chemistry by means of lectures and laboratory instruction.
(2.) One who lectures on physics, and also teaches some mathematics.
(3.) One who teaches botany, physical geography, and zoology, is curator of our museum and botanieal garden, and president of the Scientific Society, and also does a little classical work.
(4.) And one who has for some time assisted the chemical master in the laboratory and in examinations.

J. Percival,
Clifton College, Head Master.
October 19th, 1870.

---

11. Rugby School.

School House, Rugby,
October 28th, 1870.

Dear Sir,

I beg now to enclose with this, in reply to your inquiry of July 22nd last, two short printed statements on the subject of scientific instruction in Rugby School, by the two masters who principally teach in that department.

Boys are allowed considerable latitude of choice in reference to the particular branch of natural science, &c., which they prefer.

All the middle school, 270 in number, are always engaged with some branch of that subject, and half the upper school, or thereabouts. This upper school is 180 strong, so that there are 270 middle school
+90 upper school

or 360 out of the total of the school (which may be put at 500) so engaged.

I should add that special buildings for experiments, and lecture theatres with apparatus, &c., have been rather elaborately and expensively provided within the last few years. I enclose a list of honours gained by late pupils.

I hope this may prove a satisfactory account, and shall be happy to supplement the information now given if required.

I am always
Your obedient servant,
J. Norman Lockyer, Esq. Henry Hayman.

List of Natural Science Honours in Rugby School from 1851.

1851	F. Hort	1st Class Nat. Sc. Tripos	Cambridge.
1853	A. A. Harrison	Do. do. do.	Do.
1854	J. W. Woodall	1st Class Nat. Sc.	Oxford.
1855	R. H. Scott	1st Honours in Expl. Sc.	Trin. Coll. Dublin.
1864	S. S. Brown	1st Class Nat. Sc.	Oxford.
1864	G. H. West	Nat. Sc. Studentsh. Ch.Ch.	Oxford.
1867	F. W. Fison	Nat. Sc. Studentsh. Ch.Ch.	Oxford.
1868	G. H. West	Burdett-Coutts' Geological Scholarship	Oxford.
1868	G. B. Longstaff	Nat. Sc. Scholarship, New College	Oxford.
1869	E. Cleminshaw	Nat. Sc. Postmastership, Merton College	Oxford.
1870	S. Lupton	Nat. Sc. Studentsh. Ch.Ch.	Oxford.
1870	H. H. Johnston	Whitworth Exhibition	Oxford.
1870	C. S. Taylor	1st Class Nat. Sc.	Oxford.

The following account was written as a contribution to Mr. Farrar's Paper, read before the British Association in September 1866, on Natural Science in Public Schools, and is printed at Dr. Butler's request:—

Natural Science Teaching at Rugby School.

It will be convenient to arrange my remarks under the following heads:—

(1.) A sketch of the system adopted before 1864.
(2.) The changes proposed by the Commissioners.
(3.) The changes actually adopted, and the present working of the system.
(4.) Remarks on the results.

(1.) Before the summer of 1864, a boy on entering Rugby might signify his wish to learn either Modern Languages or Natural Science; the lessons were given at the same time, and, therefore, excluded one another. If he chose Natural Science he paid an entrance fee of 1*l*. 1*s*., which went to an apparatus fund, and 5*l*. 5*s*. annually to the lecturer. Out of the whole School, numbering from 450 to 500, about one tenth generally were in the Natural Science classes.

The necessary consequences of this system, and its inherent defects, are pointed out in the Report of the Commissioners on Public Schools, vol. i. p. 278, to which, for the sake of brevity, I refer.

(2.) The changes proposed by the Commissioners may be seen in the same volume, p. 299. In brief, they are as follows:—That it should no longer be an alternative with Modern Languages, but that all boys should learn some branch of Natural Science. That there should be two principal branches, one consisting of Chemistry and Physics; the other of Physiology and Natural History, animal and vegetable; and that the classes in Natural Science should be entirely independent of the general divisions of the School, so that boys might be arranged for this study exclusively according to their proficiency in it.

(3.) It must be understood that Rugby School is divided for teaching purposes into five parts. The highest consists of the Sixth Form, with about 45 boys. The next is the Upper School, containing four forms, or about 135 boys; the next is the Upper Middle School, with about 140 boys; then the Lower Middle School, with about 130 boys; and, lastly, the Lower School, with about 50 boys. The average ages of the boys in these five divisions will not be far from 18, 17, 16, 15, 14, respectively. The object of the division of the School into these parts is to enable a small number of Mathematical and Modern Language Masters to teach the whole School; and each of these divisions, it will be understood, is doing the same kind of work at the same time.* So, for example, on the mornings of Monday, Wednesday, and Friday, after breakfast, the Upper School have their Mathematical lessons, and, therefore, no other division of the School is at Mathematics at that time; and this number of boys, about 135, is arranged in six Mathematical classes or *sets* according to their proficiency.

The necessity of the existence of these divisions is so obvious that it is rather surprising that the Commissioners should have overlooked it, and should have recommended that *the whole School*, and not only one of the divisions of it, should be rearranged for Natural Science. Hence this part of their recommendations was set aside.

Again, the subjects recommended were Physiology, animal and vegetable, and Chemistry and Physics. But there exists at present but one School which can be used as an Experimental School. For there is only one School which is used exclusively by the Masters who teach Natural Science, and it would be impossible to prepare an experimental lecture in any other School. Restrictions such as these, and others which it would be tedious to explain in detail, have caused the adoption of the system I shall proceed to describe, which must be considered as the system of the Commissioners in spirit, adapted to meet the exigencies of the case.

In the Lower School no Natural Science is taught at all. In the Lower Middle and Upper Middle Schools all do Natural Science, two hours a week in School, and as much time for preparation, being given to Science; in the Upper School, it is alternative with German, and in the Sixth Form it is optional. In the Lower Middles there are four sets in Natural Science, in the Upper Middles four sets, in the Upper School two sets, and in the Sixth Form one set. This is the existing state of things, and may be from time to time slightly modified. It would be a simple matter to arrange the work if boys entered at one time only of the year, and into only one part of the School; but the facts are most inconvenient. At the beginning of each of the three Terms, new boys come into the Upper and Lower Middle School, and others are promoted from the Lower to the Upper Middles, from the Upper Middles to the Upper School, and from the Upper School to the Sixth. It is not only difficult, but quite impossible, that all these new and promoted boys can find sets into which they can easily be placed, and every plan must be a compromise. The general arrangement is this, that new boys shall do Botany their first year, Mechanics their second, Geology their third, and Chemistry their fourth; and the year begins in January.[*] The new boys of January, and the previous September, are arranged at that time into as many Botanical sets as is requisite; generally one in the Upper Middles, and two in the Lower Middles; and continue at this subject for one Term. At Easter promotions take place; some few of the Botanists, two or three, perhaps, of the Upper Middles find themselves in the Upper School, and have to give up Botany; the promoted Botanists of the Lower Middles fall naturally into the Botanical set of the Upper Middles; but what is to be done with the new boys, and those promoted from the Lower School, who find themselves at Easter in the Lower Middles? To meet this difficulty the two Botanical sets, or their remains, in the Lower Middles, are arranged in order of proficiency, and the first part goes on with the subject under one Master, and the last, with the new boys, begins over again. And without increasing the number of the Natural Science Masters, and, therefore, increasing the school terms, no plan can be hit upon which shall avoid some such inconvenience as this. The new boys who come in October are too numerous to treat in this way, and they are constituted into sets by themselves in the Upper and Lower Middles, and do some small by-subject for a single Term, such as some branch of Physical Geography, and then fall into the regular course in the following January. In January, then, the Botanical sets begin for the new comers, and the mechanical sets for those who have been one year in the School, and similarly the Geological sets. So that in the Lower Middles there is one Mechanical and one Physical Geography, and two Botanical sets; in the Upper Middles, two Mechanical, and one Geological, and one Botanical; and in the Upper School, no Botanical, one Geological, and one Chemical set. In the Sixth, one Chemical set.[†]

---

* Vide Time table in the Appendix.

I fear the above will be difficult to follow; but it cannot be made simple, as the circumstances, and, therefore, the arrangements, are more or less complicated.

Next as to the nature of the teaching.

In Botany, the instruction is given partly by lectures and partly from Oliver's Botany. Flowers are dissected and examined by every boy, and their parts recognised and compared in different plants, and then named. No technical terms are given till a familiarity with the organ to be named or described has given rise to their want. The terms which express the cohesion and adhesion of the parts are gradually acquired until the floral schedule, so highly recommended by Henslow and Oliver, can be readily worked. Fruit, seed, inflorescence, the forms of leaf, stem, root, are then treated; the principal facts of vegetable physiology illustrated; and the principle of classification into natural orders explained, for the arrangement of which Bentham's "Handbook of the British Flora" is used. Contrary to all previous expectation, when this subject was first introduced it became at once both popular and effective among the boys. The spirit of the teaching is unquestionably derived from the brilliant "Leçons Élementaires de Botanique fondées sur l'analyse de 50 plantes vulgaires, par M. Emm. le Maout," a model of an elementary work on Natural Science. There is no elementary work in English on any scientific subject which can be considered as equal to it. If anyone thinks Botany dry and uninteresting, and consisting of words alone, let him get Le Maout, and he will be fascinated by the lucidity of his style and the interest he throws round the subject.

The lectures are illustrated by Henslow's nine diagrams, by a large and excellent collection of paintings and diagrams made by the lecturers and their friends, and by Botanical collections made for use in lectures. The principal lecturer on this subject is Mr. Kitchener. When the year's course is over, such boys as show a special taste are invited to take Botanical walks with Mr. Kitchener, to consult with him the School Herbarium, and are stimulated by prizes for advanced knowledge and for dried collections, both local and general.

In Mechanics, the lecturer is the Rev. T. N. Hutchinson, M.A., F.C.S., the senior Natural Science Master. The lectures include experimental investigations into the Mechancial powers, with numerous examples worked by the boys; into the elements of Mechanism, conversion of motion, cams, the steam engine, the equilibrium of roofs, bridges, strength of materials, &c. They are illustrated by a large collection of models, and are very effective and popular lectures.

In Geology, the lecturer is Mr. Wilson. This subject is only temporarily introduced, on account of the want of another Experimental School. When this is built, the third year's course will be some part of Experimental Physics, in which there already exists at Rugby a fair amount of apparatus. It is very desirable that boys should obtain some knowledge of Geology, but it is not so well fitted for School teaching as some of the other subjects, on several grounds. Perhaps a larger proportion of boys are interested in the subject than in any other, but the subject presupposes more knowledge and experience than most boys possess, and their work has a tendency to become either superficial or undigested knowledge derived from books alone. The lectures include the easier part of Lyell's "Principles," *i.e.*, the causes of change now in operation on the earth; next, an account of the phenomena observable in the crust of the earth; stratification and its disturbances, and the construction of maps and sections; and, lastly, the history of the stratified rocks and of life on the earth. These lectures are illustrated by a fair Geological collection, which has been much increased of late, and by an excellent collection of diagrams and views to illustrate Geological phenomena.

In Chemistry, the lecturer is Mr. Hutchinson. He has an excellent lecture room, and a small but well-fitted laboratory, and he takes his classes through the non-metallic and the metallic elements: the lectures are fully illustrated by experiments. Boys, whose parents wish them to study Chemistry more completely, can go through a complete course of practical analysis in the laboratory, by becoming private pupils of Mr. Hutchinson. At present, 18 boys are studying analysis.[*]

This being the matter of the teaching, it remains to say a few words on the manner. This is nearly the same in all the classes, *mutatis mutandis*: the lecture is given, interspersed with questions, illustrations, and experiments, and the boys take rough notes, which are recast into an intelligible and presentable form in note books. These are sent up about once a fortnight, looked over, corrected, and returned; and they form at once the test of how far the matter has been understood, the test of the industry, care, and attention of the boy, and an excellent subject for their English composition.

Examination papers are given to the sets every three or four weeks, and to these and to the note books marks are assigned which have weight in the promotion from Form to Form. The marks assigned to each subject are proportional to the number of hours spent in School on that subject.

There are School prizes given annually for proficiency in each of the branches of Natural Science above mentioned.

This leads me, lastly, to speak of the results.

(4.) First, as to the value of the teaching itself; secondly, as to its effects on the other branches of study.

There can be no doubt, I think, that at Rugby the experiment has been tried under very favourable circumstances. The Head Master has been not only favourable to the movement, but has almost originated it, and sympathises heartily with the promotion of education by means of Natural Science; and the Natural Science Masters whom he has are men of some experience and enthusiasm for their work, and carefully watch the results of their teaching. I think the experience gained at Rugby points to these conclusions. That Botany, structural and classificatory, may be taught with great effect, and interest a large number of boys, and is the best subject to start with. That its exactness of terminology, the necessity of care in examining the flowers, and the impossibility of superficial knowledge, are its first recommendations; and the successive gradations in the generalizations as to the unity of type of flowers, and the principles of a natural classification, are of great value to the clever boys. The teaching must be based on personal examination of flowers, assisted by diagrams, and everything like cram strongly discouraged.

Mechanics are found rarely to be done well by those who are not also the best Mathematicians. But it is a subject which in its applications interests many boys, and would be much better done, and would be correspondingly more profitable, if the standard of Geometry and Arithmetic were higher than it is. The ignorance of Arithmetic which is exhibited by most of the new boys of 14 or 15 would be very surprising, if it had not long since ceased to surprise the only persons who are acquainted with it; and it forms the main hindrance to teaching Mechanics. Still, under the circumstances, the results are fairly satisfactory.

The Geological teaching need not be discussed at length, as it is temporary, at least in the Middle School. Its value is more literary than scientific. The boys can bring neither

---

[*] Since this was written, it has been thought better to make the course begin in September instead of in January.

[†] From September 1866, to July 1867, the subject of lectures to the Sixth Form is Electricity and Magnetism. They are given by Mr. Hutchinson.

[*] For the last few years there have been from 30 to 50 in the Laboratory.—T. N. H., October, 1873.

Mineralogical, nor Chemical, nor Anatomical knowledge; nor have they observed enough of rocks to make Geological teaching sound. The most that they can acquire, and this the majority do acquire, is the general outline of the history of the earth, and of the agencies by which that history has been effected; with a conviction that the subject is an extremely interesting one. It supplies them with an object rather than with a method.

Of the value of elementary teaching in Chemistry there can be only one opinion. It is felt to be a new era in a boy's mental progress when he has realized the laws that regulate Chemical combination, and sees traces of order amid the seemingly endless variety. But the number of boys who get real hold of Chemistry *from lectures alone* is small, as might be expected from the nature of the subject. Not more than the non-metallic elements should enter into the School course.

Of the value of experimental teaching in Physics, especially Pneumatics, Heat, Acoustics, Optics, and Electricity, there can be no doubt. Nothing but impossibilities would prevent the immediate introduction of each of these subjects in turn into the Rugby curriculum.

The decided opinion of those who have given most attention to the subject is, that Experimental Physics ought to form the staple of scientific teaching at Schools. The Report drawn up by the Committee of the Council of the British Association will enter fully into this matter.

Lastly, what are the general results of the introduction of scientific teaching in the opinion of the body of Masters? In brief it is this, that the School as a whole is the better for it, and that the scholarship is not worse. The number of boys whose industry and attention is not caught by any School study is markedly less; there is more respect for work and for abilities in the different fields now open to a boy; and though pursued often with great vigour, and sometimes with great success, by boys distinguished in Classics, it is not found to interfere with their proficiency in Classics, nor are there any symptoms of overwork in the School. This is the testimony of Classical Masters, by no means specially favourable to Science, who are in a position which enables them to judge. To many who would have left Rugby with but little knowledge, and little love of knowledge, to show as the results of their two or three years in our Middle School, the introduction of Science into our course has been the greatest possible gain: and others who have left from the Upper part of the School, without hope of distinguishing themselves in Classics or Mathematics, have adopted Science as their study at the Universities. I am confident that no Master in Rugby School would wish to give up Natural Science and recur to the old curriculum.

J. M. WILSON.

APPENDIX.—ARRANGEMENT OF TIME, JANUARY 1867.

—	Monday.					Tuesday.				Wednesday.					Thursday.				Friday.					Saturday,		
	1.	2.	3.	4.	5.	1.	2.	3.	Ex.	1.	2.	3.	4.	5.	1.	2.	3.	Ex.	1.	2.	3.	4.	5.	1.	2.	3.
SIXTH - -	C	F	C		C	C.	T	M		C	C	GN	M	C	C	C			C	C	GN	M	C	C	T	D
UPPER SCHOOL -	C	M	T		C	C	C	V.2 only. Cm.		C	M	C	T	GN	C	C	D EF EM		C	M	C		GN	C	F	D EM
UPPER MIDDLE	C	C	M		C	C	N	Cm.	D EF EM	C	T	M	F	C	C	M	Cm.	C*	C	T	C	F	C	C	N	D EF EM
LOWER MIDDLE	C	C	F		C	C	M	Cm.	C*	C	T	C	N	C	C	F	Cm.	D EF EM	C	T	M	N	C	C	M	D EF EM

C Classical Lesson.
Cm. Composition.
C* Looking over Verses.
T Tutor Subject.
M Mathematics.
N Natural Science.
G German.
F French.
EF Compulsory Extra French Lesson.
EM Compulsory Extra Mathematical Lesson.
D Drawing Lesson.

SCIENCE WORK IN RUGBY SCHOOL.

In September 1866, Mr. Farrar, of Harrow, read a paper before the British Association on the subject of Natural Science teaching in Public Schools, to which my friend and colleague, Mr. Wilson, contributed a sketch of what we were doing at Rugby. This was printed separately, and has been found very useful to parents of Rugby boys, as well as to others interested in education.

Since that time, however, important changes have been made in our work, which has undergone extension and modification in various ways.

I have, therefore, at the request of others, drawn up the following brief account of our arrangements for the systematic teaching of Natural Science as they are at present carried out.

In two or three places I have quoted *verbatim* from Mr. Wilson's paper, and, in the closing paragraphs, I have gladly availed myself of his remarks on the results of the more extended teaching of Science in our School.

T. N. HUTCHINSON, M.A., F.C.S.,
Senior Natural Science Master in Rugby School.

Natural Philosophy was first introduced into Rugby as a subject of School instruction by Dr. Tait in 1849. The lecturer was a resident physician in the town, an F.R.S. His lectures, which included Chemistry and Physics, were delivered in the Town Hall, and attendance was voluntary. Dr. Goulburn afterwards appointed successively two of the Classical Masters who had strong scientific tastes to carry on the instruction in Natural Philosophy. After Dr. Temple became Head Master, the Natural Science work was undertaken by one of the Mathematical Masters, and, in 1859, the Trustees added a lecture room and Laboratory to the School buildings, thus giving considerable impulse to the new studies. Soon after this another Mathematical Master took part in the Natural Science teaching, and Botany was added to the subjects of instruction, in addition to Chemistry, Geology, and Physics. During this time, however, Natural Science was only taught as an alternative subject. A boy upon entering the School had to choose between Natural Science and Modern Languages. He could not learn both, as the lessons were given at the same hours. The number of boys who chose Natural Science was, on the average, about one tenth of those in the whole School.

In January 1865, in consequence of the recommendations of the Royal Commissioners, a Natural Science Master was appointed, whose time was to be wholly devoted to Science teaching, two of the Mathematical staff assisting him.

"It must be understood that Rugby School is divided, for teaching purposes, into five parts. The highest consists of the Sixth Form, with about 45 boys. The next is the Upper School, containing four forms, or about 135 boys; the next is the Upper Middle School, with about 140 boys; then the Lower Middle School, with about 130 boys; and, lastly, the Lower School, with about 50 boys. The average ages of the boys in these five divisions will not be far from 18, 17, 16, 15, and 14, respectively.

"The object of the division of the School into these parts is to enable a small number of Mathematical and Modern Language Masters to teach the whole School; and each of these divisions, it will be understood, is doing the same kind of work at the same time. So, for example, on the mornings of Monday and Thursday, after breakfast, the Upper School have their Mathematical lessons, and, therefore, no other division of the School is at Mathematics at that time; and this number of boys, about 135, is arranged in six Mathematical classes, or *sets*, according to their proficiency.

"The necessity of the existence of these divisions is so obvious that it is rather surprising that the Commissioners should have overlooked it, and should have recommended that the *whole school*, and not only one of the divisions of it, should be rearranged for Natural Science. Hence this part of their recommendations was set aside."

For the first half-year of 1865, Natural Science was taught to every boy in the Middle and Lower School, the Sixth Form and Upper School being allowed to choose between German and Natural Science. After six months' experience, however, it was decided to drop the subject in the Lower School, the boys appearing hardly equal to the work.

From that time to the present, Natural Science has been taught throughout the entire Middle School, while the alternative of Natural Science or German is still allowed to the Sixth and Upper School, the division being generally pretty equally made. Meanwhile, the staff of Natural Science Masters has been increased to five, two more of the Mathematical Masters joining in the work; and, within the last year, a competent Laboratory Assistant has been engaged, part of whose duties consists in superintending the boys, at certain hours, when working at Practical Chemistry.

The new Natural Science Schools, which have only recently been completed, comprise a large working Laboratory capable of accommodating 30 boys, a private Laboratory for the Chemical lecturer, a Chemical lecture theatre with raised seats for 50, a similar but still larger theatre for Physical Science and Geology, and an apparatus room with means and appliances for instrumental work of various kinds.

The regular subjects of instruction have hitherto been Botany, Physical Geography and Astronomy, Geology, Mechanics and Mechanism, Chemistry, and Electricity, including Magnetism. Heat, Hydrostatics, and Pneumatics have also occasionally been taken in lieu of other subjects. The boys are divided into "sets," each set having two lectures a week. The lectures are strictly catechetical, and are fully illustrated by plants, diagrams, specimens, models, and experiments, as the case may be; the duration of each lecture varies from three-quarters of an hour to an hour. In addition to attendance at the two weekly lectures, the boys are expected either to show up note-books from time to time, which have been elaborated from rough notes taken in the room, or to make abstracts, or work examples, so as in very case to give evidence of having intelligently followed the lecturer. Examinations are also held from time to time, and the results are embodied in the monthly characters sent to the parents.

The subject that has been found, on the whole, to answer best for a commencement is Botany. It needs no special preparatory studies, and it serves as an excellent introduction to scientific terminology and classification; while the patience, care, and accuracy of observation required in examining and comparing the different parts of plants cannot but prove of real value in the intellectual training of boys.

The introduction of elementary astronomy has been rather a matter of convenience to suit our school arrangements. The scholastic year begins in September, when two new botany "sets" commence. A certain number of new boys, however, enter the school in January; and, as it is impossible to begin the subject over again at that time, the new boys in the middle school form a supplementary set, taking up selected portions of astronomy to last two terms. These boys then go to botany in the following September.

The new boys in the middle school at Easter form a set by themselves for commencing botany, and go on with the subject as an advanced set in September. The class-book used by the botanical lecturers is Oliver's "Lessons," but the system followed in teaching is a modification of that employed by Le Maout in his fine work, "Leçons Elémentaires de Botanique." In astronomy, Mr. Norman Lockyer's little book has been used. In no case, however, does a teacher confine himself to a single text book. In geology "the lectures include the easier parts of Lyell's 'Principles,' *i.e.*, the causes of change now in operation on the earth; next, an account of the phenomena observable in the crust of the earth; stratification and its disturbances, and the construction of maps and sections; and, lastly, the history of the stratified rocks and of life on the earth." The lectures are illustrated by a very fair School Museum, many of the specimens in which have been obtained by the boys themselves, and also by a capital collection of diagrams and drawings exhibiting geological phenomena. The subject is one that has been found to interest a large number of boys, and the local Geology has been well and vigorously worked out by past and present members of the geological sets. In Mechanics there have hitherto been two sets, one elementary and the other more advanced, each lasting a year. The subjects included in the easier course are, the so-called Mechanical powers with their various practical applications, the centre of gravity and different kinds of equilibrium, and the composition and resolution of forces. Models and diagrams are extensively employed, and the boys are required to work a considerable number of numerical examples, and to take full notes of each lecture, as no special text book is used.* In the higher set the lectures comprise:—

1st. The equilibrium of structures and frame-work, theory of girders, arches, roofs, tubular bridges, buttresses, &c., and here, again, the boys are taught practically to work out the tensions and thrusts of the different parts in a given roof or piece of frame-work, to find the breaking weight of beams of various kinds, &c.

2ndly. The elements of Mechanism, conversion of one kind of motion into another, cams, wheel work, parallel motions, &c., the different arrangements being illustrated, as far as possible, by actual working models.

3rdly. The history, theory, and mechanism of the steam engine.

The chief difficulty in teaching Mechanics satisfactorily has arisen from the ignorance of many boys in Arithmetic and Geometry. Simple as is the amount of such knowledge required to work examples in Mechanics, it is yet beyond that of a large number of boys who enter a Public School. It is proposed in future not to allow any boy to join a Mechanical set who has not reached a certain stage in the Mathematical work of the School.

The remaining subjects of Chemistry, Electricity, and Heat are not taught in lectures, except to boys in the Sixth Form and Upper School. Chemistry and Electricity have hitherto been taken in alternate years, each occupying three terms. In future, however, this will not be the case, and each boy in the Sixth or Upper School will be able to go through the three subjects of Chemistry, Electricity, and Heat in successive yearly courses.

After some years' experience, the Chemical teaching, so far as *lectures* are concerned, has been confined to the non-metallic elements. As a rule, the Chemistry of the metals does not present the same variety that is found in the study of the other elementary bodies, and there is too much apparent sameness in the preparation and properties of the different metallic salts to interest any but those who have a decided taste for Chemistry. Roscoe's Text book is adopted, and a large number of experiments are performed before the boys. At every fifth or sixth lesson a paper of questions is given on the subjects that have last occupied the attention of the class, and from the results of these papers the marks and order for the term are obtained.

In Electricity and Heat Ganot's "Physics" has been selected, and here, again, abundant experimental illustration is combined with written answers to questions and the working of numerical examples.

Till the new Laboratory was erected it was only possible to allow of a small number of boys studying Practical Chemistry. Such boys as showed a special aptitude for Chemistry might, with their parents' permission, become private pupils of the Chemical lecturer, and work at Analysis with him in the small School Laboratory. Since the large Laboratory has been finished, however, the number of boys who have availed themselves of it has been between 30 and 40 in each term, and instead of being only open to private pupils, there will now always be, in addition to these, a practical Laboratory "set," composed of picked boys who have shown special industry and intelligence in their previous Natural Science work. In this way the Laboratory will act as a stimulus and a reward to those who are really in earnest in their work. Each Laboratory pupil has two lessons in the week of about an hour and a half's duration. The books used are Harcourt and Madan's "Practical Chemistry" for beginners, and "Fresenius" for those more advanced. The boys commence with the preparation of the commoner gases and chemical substances, so as to become practically acquainted with their properties and the ordinary methods of manipulation. They then go on with the examination of the characteristic properties of the metals and acid radicles, and so to the application of these properties in the work of actual analysis.

The Laboratory instruction is given by the senior Natural Science Master, who is also the Chemical lecturer, and his assistant. The regular Laboratory "set" comes at stated hours, twice a week, the boys mostly working in pairs. The other pupils are allowed to choose such times as fall in best with their other work, and the result is that there are few hours in the day when there is not some one working in the Laboratory. This plan has the advantage of preventing the room being overcrowded, and the boys get more individual attention from their teachers.

In brief, then, the arrangement of the Natural Science work is this:—

In September the new boys in the Middle School begin Botany in two sets under different lecturers. A third Botanical set consists of those who entered the School the previous Easter. These three sets continue separate during the October and Lent terms; but, after Easter, the three are arranged according to proficiency and merged into two sets for the last term's work, and a commencing Botany set is formed, consisting of the new boys.

Two sets commence Geology, also under different masters, consisting chiefly of those who have done Botany. These two sets are combined into one after Christmas, so as to allow one of the lecturers to take the new boys in January as an Astronomy set, which is continued through two terms.

Those who have done Botany and Geology form an elementary Mechanical set, and those who have been through the elementary course form an advanced set for Mechanics and Mechanism, &c.

---

* These Lectures have been discontinued, their place being supplied by Lessons in Elementary Physics, based on Dr. Balfour Stewart's *Text Book*.—T. N. H. October, 1873.

Lastly, there is a Laboratory set for Practical Chemistry, formed as already described.

In the Sixth Form and Upper School, which are worked together, four sets are commenced in September, each lasting a year. One in Chemistry for new boys and such as are promoted from the Middle School, one in Electricity for those who have done Chemistry, one in Heat for those who have done both Chemistry and Electricity, and a small advanced Botany set for any who have shown a special desire to continue that study.

This is the general order of the work, but individual tastes are consulted as far as possible, and any boy having a strong wish to join a particular set has usually little difficulty in doing so. Indeed, I believe it to be a matter of real importance to make the system as elastic as possible.

The new boys, of whom we can know but little, are placed in Botanical sets. But during their first year some will probably have shown that their taste lies rather in the direction of Physics than Natural History, and in such cases they would be allowed to go on with Mechanics or Physics for the next year instead of Geology, which, under ordinary circumstances, would follow Botany.

With regard to the encouragements to Natural Science at Rugby I may state—

1. That marks are assigned to the Natural Science work in determining the place of each boy at the end of the term, the subject being marked in proportion to the time devoted to it.

2. The subject is included in the examination which the Sixth undergo for exhibitions in July.

3. The order of each set is published in the School "List" at Christmas and Midsummer.

4. Various prizes are given annually, one of three guineas for General Chemistry, and another of equal value for Practical Analysis. Prizes of the value of two guineas each are given for special excellence in Mechanics, Geology, and Botany. The boys are also encouraged to make collections of wild flowers, fossils, or insects, and prizes are given to the most deserving.

One of the results of the Natural Science work at Rugby has been the establishing of a School Natural History Society. The Society has been in existence now for three years, and is in a flourishing condition. Meetings are held once a fortnight, when papers are read and objects of interest in any branch of Natural History are exhibited and explained.

Reports are published annually containing the more important papers and observations of each year. Three reports have already appeared.

Such, then, has been the nature of our work and experience at Rugby during the last few years.

With regard to the opinion in which that work is held by others most interested in the matter, I cannot do better than quote the words with which Mr. Wilson's paper ends, especially as I have no reason to believe that the opinions therein expressed have been altered since the time when those words were written.

"Lastly, what are the general results of the introduction of scientific teaching in the opinion of the body of Masters? In brief it is this, that the School, as a whole, is the better for it, and that the scholarship is not worse. The number of boys whose industry and attention is not caught by any School study is markedly less; there is more respect for work and for abilities in the different fields now open to a boy; and though pursued often with great vigour, and sometimes with great success, by boys distinguished in Classics, it is not found to interfere with their proficiency in Classics, nor are there any symptoms of over-work in the School. This is the testimony of Classical Masters by no means specially favourable to Science, who are in a position which enables them to judge. To many who would have left Rugby with but little knowledge, and little love of knowledge, to show as the results of their two or three years in our Middle School, the introduction of Science into our course has been the greatest possible gain; and others who have left from the Upper part of the school, without hope of distinguishing themselves in Classics or Mathematics, have adopted Science as their study at the universities. It is believed that no master in Rugby School would wish to give up Natural Science and recur to the old curriculum."

APPENDIX.

ARRANGEMENT OF TIME. 1870.

—	Monday.					Tuesday.				Wednesday.					Thursday.				Friday.					Saturday.		
	1.	2.	3.	4.	5.	1.	2.	3.	Ex.	1.	2.	3.	4.	5.	1.	2.	3.	Ex.	1.	2.	3.	4.	5.	1.	2.	3.
SIXTH - -	C	C	C		C	C	T	M		C	C	C	GN	(M)	C	C	F		C	T	M		(M)	C	GN	
UPPER SCHOOL -	C	C	M		C	C	F	C		C	T	C	GN	(M)	C	M	C	M*	C	T	C	EF	(M)	C	GN	EM
UPPER MIDDLE -	C	F	T	M*	C	C	N	C	EF EM	C	M	F	C	(M)	C	T	C	C*	C	M	C	N	(M)	C	C	EF EM
LOWER MIDDLE	C	C	T	M*	C	C	N	F	EF EM	C	M	C	C	(M)	C	T	C	C*	C	M	F	N	(M)	C	C	EF EM
LOWER SCHOOL*	C	C	C		C	C	C	C	C	C	F	C	T	C	C	C	C	C	C	F	C	T	C	C	C	C

C	Classical, History, or Divinity Lessons.
C*	Looking over Composition.
M	Mathematical Lesson.
(M)	Unprepared Mathematical Paper.
M*	Looking over Mathematical Papers.
F	French.
G	German.
N	Natural Science.
EF	Extra French.
EM	Extra Mathematics.
T	Tutor.

The figures 1, 2, 3, 4, 5, denote respectively First, Second, Third, Fourth, and Fifth Lesson. The time for First Lesson is from 7.15 to 8.15. Second Lesson may be taken any time between 9.15 and 11.15. Third Lesson between 11.15 and 1.15. Fourth Lesson between 2.15 and 4.30, and Fifth Lesson between 4.30 and 6.

* In the Lower School the Lessons marked C are at the disposal of the Lower School Master, and need not be all Classical.

---

12. WELLINGTON COLLEGE.

Wellington College, Wokingham,
November 29, 1870.

DEAR SIR,

I HAVE the honour to enclose, in obedience to your request, a short account of the physical science teaching which forms part of our course here.

If you desire any further explanation it will give me great pleasure to afford it.

I have the honour to remain, dear sir,
Your very faithful servant,
E. W. BENSON.

J. Norman Lockyer, Esq.,
&c. &c.

WELLINGTON COLLEGE.

Physical Science.

From the opening of the College in 1859, instruction in practical chemistry has been given, in a small laboratory, to a voluntary class in the higher part of the school. No charge is made for the instruction. The average attendance, which was limited by the size of the laboratory, has been 14 boys.

In 1865, a small class for geology was formed in the Modern Department, consisting of boys not requiring classical work.

In 1867, a further change was made: geology was dropped, and it was arranged that chemistry, heat, and electricity should be taught to a larger number of boys. The system then adopted has been, with some necessary modifications, continued up to the present time. This year (1870) a new class room for chemical teaching has been built, with proper appliances, and taken into use.

Division of the School.—The modern school now contains 110 boys, about one third of the school. It is divided into an upper and middle school, the line between which is drawn, in respect of age and attainments, at about the same place as in most public schools. Most of these have, in the first instance, passed through the usual training in classics, mathematics, French, &c., of the lower forms of the classical school, at the age of 13 or 14, and are not allowed to join the modern school as a refuge from classical difficulties. Many join from the higher forms. Some, who have early reached a high position and made considerable progress in classical studies, enter it from the fifth and even the sixth forms. The latter class almost invariably enter the upper division of the modern school. A few come ready to enter the modern school at once. Hence, at leaving, about half the whole number leave from the modern side.

A main object of the modern school being to prepare boys for the higher army examinations, it is necessary to educate boys on two lines, those, viz., which are contemplated in the regulations of the examinations, and in the scale of marks fixed for them.

Marks and Prizes.—The study of science is encouraged (1) by marks, both for term work and for examination, and for helping to decide a boy's place in the school; (2), by the publication of the classes in the school roll; (3), by marks in the examination for the modern exhibition (equal to those given for each modern language, two-sevenths of those for mathematics); (4), by an annual governor's prize for practical and theoretical chemistry.

Programme.—The programme is as follows (ascending), omitting history, divinity, and English lessons :—

2nd class	Mathematics.	
"	Latin	3 hours.
"	French and German.	
"	Science	1 hour.
1st class, lower division " upper division 6th form	Mathematics	9 hours.
	Latin*	3 "
	Science or Greek,	3 "
	French and German.	

In the second class (fourth form from the top) the time is devoted chiefly to experimental lectures, the notes of which are brought, fairly written out, at the following lesson, and then looked over and returned.

Chemistry, Heat, Electricity.—A different subject is treated each term: for instance, in the Easter Term, 1870, elementary heat, in the following term the elements of magnetism and frictional electricity, both of which are continued higher up in the school. Most boys spend two terms in this form, which contains 30 boys.

In the upper school the three classes are under different masters, the highest of which contains 16 boys, the others 28, leaving boys in the Greek classes. There are three science lessons a week—two of them prepared, the third unprepared and devoted chiefly to working numerical examples under supervision of the master. In the first set, the three subjects, heat, chemistry, and electricity, occupy five terms, *i.e.*, rather less than two years; in the second set no electricity has at present been taught, but all the time has been devoted to heat and chemistry, treated in a more elementary way than in the first set. No boy is promoted into the first set until he has gone, at least once, through the elements of heat and of chemistry. A boy of fair ability, spending three years in the upper school, will thus go through heat and chemistry twice, and through electricity once. Ths difference in the mode of treatment of the same subject constitutes the difference between the two sets, and we find that, upon the whole, the gradations of knowledge are as clearly marked and unnecessary repetitions as much avoided as in the teaching of classics and mathematics. In one point we have a distinct advantage, namely, that all the modern school give a great deal of time to mathematics, and that the promotion in science very nearly corresponds with that in mathematics. There is, therefore, a marked difference between the capacity of the two sets for working numerical examples.

The work required to be done out of school consists of fairly written out notes of experiments, of numerical examples, and of prepared portions of text books. The time in school is spent questioning upon what has been prepared or written, and in experiments and illustrations. The lessons oscillate in fact between school-lessons, properly so called, and lectures. Neither system is rigorously adhered to.

The text-books in all are Ganot's "Physics," Ferguson's "Electricity," and Barff's "Chemistry." For the lower boys, Tate's small hand-books are used, though, as above stated, the teaching is chiefly *vivâ voce.*

(H. W. Eve.)

Laboratory Class.—In the laboratory class the pupils learn from three to five pages of Fownes' or Roscoe's "Manuals of Chemistry" in the week. Once a week they are examined, and, if found sufficiently acquainted with the portion, are directed in preparing for themselves such experiments as will illustrate the week's work. For this purpose, a laboratory is arranged to accommodate 10 or 12, as many as one teacher can direct at a time. An hour a week is given to practical working in the laboratory, and a quarter of an hour to the examination in the week's work. The senior class, in which there are pupils of the third year, is sufficiently advanced to make most of the chemical substances used in the arts and manufactures, and to conduct a simple analysis. At the end of each term the pupils are examined by written questions, and are required to make some chemical substance, and to conduct a simple analysis.

(J. G. Barford.)

Many of the boys who learn chemistry in the ordinary classes avail themselves of the opportunity of attending the laboratory for two or three terms.

Science Classes.—In the experimental science classes, the lessons are chiefly by lecture, and the boys are required to take notes of all that they see and hear. A chief feature in each lesson is the numerical exercises given to the boys. They are taught, where it is practicable, to reduce all phenomena to figures, and, by this means, although some of the younger boys have a knowledge of mathematics not extending beyond the elementary rules in algebra, we believe that they are led to take a greater interest in the purely mathematical work from finding a practical purpose to which it can be applied.

(Carlton Lambert.)

Mechanics.—Statics and dynamics are taught in the first mathematical sets in the modern school. The text books are Goodwin's and Todhunter's "Elementary Treatises." These subjects have been treated theoretically, but more opportunity is now about to be given to the boys of seeing the theorems which they use put to the test of experiment. The time devoted to mathematics in the first set is nine hours a week in school, and work is given which occupies about seven hours in their own rooms, thus making a total of about 16 hours a week. Of this time nearly two thirds is devoted to mechanics and hydrostatics. The teaching is by lecture occasionally, when the subject is within the grasp of the whole class, but generally by individual attention. The number of boys in this set is about 13, and the average time during which they continue in the set is about one year.

(C. L.)

Hydrostatics.—Those boys in the 1st set who have thoroughly mastered mechanics, so far as to be able to solve simple problems in "energy," and the oscillation of cycloidal pendulums, devote their time to hydrostatics. The text book used is Besant's "Elementary Treatise," and attention is chiefly given to problems on specific gravity, condition of equilibrium and stability of floating bodies, and the relations between the pressure, density, and temperature of a gas or vapour, with the application to natural phenomena.

(C. L.)

Optics.—Between Christmas and Easter this year, as an experiment, a course of six voluntary lectures was given by Mr. Airy, one of the masters, treating the subjects elementarily and using only geometrical methods. There was an average attendance of 22 boys, about half of whom were in the classical school; and, by the numbers who came on the day succeeding each lecture, by invitation, to ask questions arising out of the lectures, they appeared to be much interested. Several of them prepared good diagrams. An examination was held, and parts of Airy's work on "Geometrical Optics" were marked for private study, and a prize was given at the end of the term for the examination. The result was satisfactory.

Botany.—Two annual prizes have been always given for the best collection of specimens of wild flowers.

But, for the last four years, it has been attempted to make this collecting more instructive by limiting the number of plants to be sent in, and requiring descriptive schedules (Henslow's) to be sent in with each plant. A portion of Oliver's *Botany* is also prepared, and examined in by papers.

For the two terms after Christmas 1869, botany was introduced into the highest form of the classical middle school as an alternative for German. There were two weekly hours in school assigned to the subject. But the prospects of various competitive examinations determined boys and parents, possessing a choice, so much in favour of German, that although botany was a decidedly popular subject with the boys who learnt it, it was found better to suspend teaching it until it can be re-introduced as a necessary and not optional subject on a larger scale. Only a fourth part of the boys undertook it, and these diminished as the claims of German appeared nearer.

"I used Oliver's *Lessons* as the text-book, and after the breaking up of the frost, Dr. Lindley's *Descriptive Botany,* to enable boys to fill up schedules and describe the different parts correctly. Until technical terms were mastered, we worked with reading, *vivâ voce* questioning, and short papers, and illustrated the lessons with drawings on the black board, and dried plants. As spring advanced, I supplied each boy with a specimen for dissection and examination, and floral schedules were filled up. After promotions at end of first term, the change in the class made it apparent that, in order to teach effectually, two sets were necessary. Boys who began when flowers were plentiful made more rapid progress. Mr. Kitchener, of

---

* With an alternative of history and modern languages.

Rugby, examined them at Midsummer, and considered that they had very fairly marked the first part of the subject."

(C. W. Penny.)

At present the prizes for collections and schedules continue as before.

Natural History Society.—A Natural History Society was founded early in 1868, and has flourished. The meetings, held once a fortnight, have been numerously attended: the members, who number about 20 boys, have the power of introducing others to the lectures. The average attendance at the meetings is 30 or 40, and is often much more numerous, and various interesting papers have been read, contributed by the boys themselves. Professor Kingsley and Professor Rupert Jones have taken great interest in the society, and, as well as other friends and masters, have frequently delivered lectures and addresses to them.

The Report for 1869 is enclosed.

(Signed) E. W. Benson, D.D.,
Master.

13. University College School.

Report on Science Teaching in University College School, London, Dec. 1870.

Introduction.

University College School, as at present constituted, was founded in January 1832, under the joint Headmastership of Professor Key and Professor Malden.

At the end of session 1841–2, Professor Malden resigned his share in the Headmastership, continuing, however, to act as Supervising Examiner down to August 1868, and making, in that capacity, an Annual Report on certain classes selected by him, as time and circumstances allowed, from year to year.

Extracts are given from the following sources of information:

(1.) The MS. Reports of the Headmaster to the Council of the College.
(2.) The MS. Reports of the Supervising Examiner, Professor Malden.
(3.) The Reports of the Council to the Members of the College.
(4.) The communications of the Masters engaged in science teaching.
(5.) The Report furnished in 1866–7 to the Schools Inquiry Commission. [Vol. x. p. 223.].
(6.) The Headmaster's evidence given before the same Commission in 1865. [Vol. iv. p. 313.]
(7.) The Report of the French Commissioners, MM. Demogeot and Montucci, on Secondary and Superior Education in England and Scotland, Vol. ii. Paris, 1870.

The Statistical Tables are compiled from the printed prize lists of the school.

Appended are:

(1.) A copy (in proof) of the programmes of work in the science classes, strictly so-called, and the cognate classes.
(2.) A copy of Mr. Orme's syllabus of lectures on chemistry, printed for the use of the school, but not published.
(3.) Specimen copies of examination questions in the science classes, 1865–9.
(4.) Specimen copies of the school prize lists for 1840, 1855, 1857, 1867, 1869, 1870.

REPORT.—Part I.

Account of the Science Classes and arrangements for Science teaching in University College School, from its first establishment down to the end of Session 1869–70, *viz., July* 28, 1870.

Sessions 1832–3—1834–5.

Schools Inquiry Commission (Minutes of Evidence) Vol. iv. p. 313, Professor Key, M.A., F.R.S., Headmaster of University College School, examined, 3rd May 1865.

Question 3003.—Is the general system of instruction in the school nearly the same as it has been since the establishment of the school?—Chemistry has been introduced, which was not taught at first, and when it was first taught it was not taught practically.

You have always had some branches of physical science?—Yes; natural experimental philosophy, and further than that, applied mathematics; but then that is for a small number.

When you first knew the school, what branches of physical science were taught?—But little was done in this way, simply because, at the beginning, our boys were too young. We had very few old boys for a year or two.

Were the ordinary sciences of observation, botany, and zoology, taught?—Occasionally we have had botany taught, but only occasionally.

3057. Has it been tried with specimens? Has it been demonstrative?—Yes; but not systematically. My reasons for not applying our time to botany are these: it is difficult for us to obtain specimens in sufficient quantity for all the boys in a class to handle them; and even then without a magnifying glass little can be done. If a boy is not to handle the object, his observing powers are not called into play. But the science of classification, it is said, is taught in botany. Such, however, is the case in all sciences, in that of language itself, for example. At any rate, botany is a better subject for country schools than for us.

3,008. Do you attach more importance to the experimental sciences?—Yes; we found we were not doing much good in the other sciences.

Do you conceive that the teaching of all these subjects of physical philosophy is imperfect unless you can make the boys use their own hands?—I should say so.

Apart from these points the general system of the school is nearly as it was constructed originally?—Very nearly indeed.

Note on foregoing extract.

The printed "Prize Lists" specify the following classes, which may be given as an illustration.

Session 1833–4. I. (*i.e.* beginning) Class and Upper II., class in "Objects."
,, 1834–5. Upper II. and Lower III., "Objects;" Upper III., "Natural History."
,, 1835–6. Lower III., "Objects."
,, 1836–7. Lower II., "Objects." Mixed Class of Non-Grecians: "Physical Geography and Astronomy."
,, 1837–8. Lower III., "Vegetable substances used for Food."
,, 1838–9. Upper III., "Objects." Upper III. Vegetable substances."
,, 1839–40. Lower IV., "Natural History."

The text-book employed in the object classes was Miss Mayo's "Lessons on Objects," *e. g.* metals, natural products, such as camphor, gum arabic, &c. These lessons were eventually discontinued, as they tended to degenerate into mere teaching of the meaning of hard words.

For natural history one of the volumes of the "Peter Parley" series formed a text-book. The museum of the college was occasionally put under contribution for illustrative specimens. The lower fourth class in this subject, in session 1839–40, was conducted by Professor Malden.

The volumes entitled "Fruit and Timber Trees" and "Vegetable substances used for Food," forming part of the "Library of Entertaining Knowledge," were used in the upper and lower divisions respectively of the third class.

Another volume of the same series, "Menageries," was used in the beginning classes.

Session 1835–6.

The Upper VI. class of pure mathematics was under the charge of Professor White, of University College. The same boys received instruction in natural philosophy:—the first instance of the introduction of this subject into the school. Vide remarks on table No. 1 in Appendix.

The 1st and 2nd prizemen in natural philosophy were prizemen in the same order in the VI. Latin class also. The former obtained at the same time the highest prizes in German and in Geometry.

To this session belongs likewise the formation of a class of purely experimental physics; a mixed class of "non-Grecians" reading Hydrostatics.

In the following session, the prizeman in applied mathematics, J. G. Greenwood, gained also the highest prizes in Latin and in Geometry.

Mr. Greenwood graduated at the London University in 1840, obtaining the University Scholarship in classics, and is now Principal of Owens College, Manchester.

Session 1838–9.

The VI. class of mechanics, under Mr. Cook, numbering in the second term 20 boys, had three lessons of one hour per week, and read as text-book Whewell's "Mechanical Euclid." The non-Grecians of classes VI. and V., also under Mr. Cook, numbering in the second term 19 boys and likewise receiving three lessons of one hour per week, read the Useful Knowledge Society's "Lives of Galileo and Kepler," with illustrations by the master. The same class had in former years been accustomed to use Webster's "Elements of Physics."

The non-Grecians of class upper IV. (24 boys in the second term), under Mr. Webster, had two weekly lessons of one hour, and read the Useful Knowledge Society's "Introduction to Natural Philosophy." The same boys had one lesson every week with Mr. Cook on the use of the globes.

Session 1839–40.

The VI. class received two lessons of three-quarters of an hour weekly in applied mathematics, and four lessons of similar length in experimental physics, including (exceptionally) chemistry.

The prize in applied mathematics was awarded to E. A. Bowring (now C.B. and M.P.), who was also first prizeman in the VI. Latin class.

The upper V. class received four lessons of three-quarters of an hour in experimental physics, using Webster's "Elements."

The prizeman in this class, L. Field, obtained the prize in chemistry in the B.A. examination (London) in 1844, and is now Fellow of University College.

The upper IV. class received one hour's lesson a week in objects, with special reference to arts and manufactures.

The lower IV. class spent three hours a week on Natural History.

Session 1840–1.

The VI. applied mathematics met for two periods of three-quarters of an hour, and the same boys gave four periods to experimental physics.

The lower V. class gave three periods and the IV. class four periods to natural philosophy.

Session 1843–4.

Examiner's Report.

In the examination of the sixth class in mathematical natural philosophy I read over the papers of the *second* boy, Hayward, and found them remarkably well done. Mr. Cook's examination was a very judicious one, but at the same time implied a considerable knowledge of elementary mechanics in the boys submitted to it; and I was glad to find by his report that rather more acquitted themselves fairly than in the pure mathematics.

The lower V. class, under Mr. Ellis, was examined in the elements of natural philosophy without mathematics, but with arithmetical calculations. The examination was certainly elementary and very easy, but I did not think the worse of it on that account. On the contrary, I thought it judicious. Nine boys were "mentioned."

Note.

In applied mathematics, seven boys were "mentioned."

In differential and integral calculus, six boys were "mentioned."

In geometry, algebra, and trigonometry, five boys were "mentioned."

The "second boy" in applied mathematics, Robert B. Hayward, was fourth wrangler in 1850, and became Fellow of St. John's.

The "first boy" on the same occasion was Geo. V. Yool, third wrangler in 1851, and subsequently Fellow of Trinity.

Session 1849–50.

Examiner's Report.

Mr. Spencer's two classes in natural philosophy and chemistry may be taken together, as they consisted of nearly the same boys. His senior classes in these subjects did very well.

The junior classes consisted of older boys, but boys of inferior power generally, and it so happened that the classes had dwindled down by the boys, from time to time, leaving the school. These juniors did not do well.

Session 1850–1.

Mr. Spencer's Report to Headmaster.

In natural philosophy, my classes are entirely experimental. During the past year we have read mechanics and hydrostatics, but in the previous session we had an experimental course on electricity, magnetism, and electromagnetism, besides a short course on the history and structure of the steam engine.

In chemistry, we devote ourselves entirely to inorganic chemistry.

I may mention that a very good chemist has this year spoken very highly of the papers sent in by the first and second boys in each class.

Note.

The "first boy" in the senior class was Michael Foster, subsequently B.A., with University Classical Scholarship, and M.D., London, now Prælector in Physiology at Trinity College, Cambridge, and late Professor of Practical Physiology at University College, London.

The "second boy" in the same class was William Stanley Jevons, now M.A., London, and Gold Medallist, and Professor of Logic at Owens College, Manchester.

Session 1851–2.

Headmaster's Report.

Mr. Cook's VI., mathematical mechanics and hydrostatics, &c., was a "great improvement on former years," which he chiefly attributes to the use of an improved textbook.*

In Mr. Cook's V., experimental natural philosophy and the higher arithmetic, some did remarkably well, but, on the whole, the class was somewhat below the average.

Mr. Spencer's mathematical classes consist, for the most part, of boys unable to go on with Mr. Cook's classes, so that any demerit of theirs is not fairly attributable to their teacher. But the upper part of all his three classes passed a very satisfactory examination.

The four classes in experimental natural philosophy and chemistry (two of each), which are conducted by Mr. Spencer, appear to have been in a very creditable condition; and I am the more disposed to rely upon his report when I find that in Professor Graham's class of chemistry in the college both the silver medals in 1851–2 have been won by students who had been boys in the school in the previous session, viz., F. H. Robarts and W. S. Jevons.

Note.

In the VI., applied mathematics, equal prizes were given to Joseph Chamberlain, now chairman of the Executive Committee of the National Education League; and to F. Manning Needham, B.A., Lond., in 1855, and third in mathematical honours.

The first prize in Mr. Spencer's senior class of experimental physics was awarded to Edwin Lawrence, now B.A. and LL.B., Lond., in honours, and Assoc. Inst., C.E.

The Rev. Wm. Brock, of Hampstead, was first prizeman in chemistry (senior class). He matriculated from the school in 1853.

The Rev. F. H. Robarts matriculated in 1852 as fourth in honours in classics and fourth in chemistry.

Session 1852–3.

Examiner's Report.

I was particularly struck and very much pleased with the answers of the boys in the sixth class, under Mr. Spencer, in experimental natural philosophy. They appeared to have been thoroughly well taught, and the examination was judicious.

In like manner, so far as I am able to judge, I would report very favourably of the senior class of chemistry.

Session 1853–4.

Examiner's Report.

I was much pleased with the examination of the lower VI. class in experimental natural philosophy; and I was gratified in a very high degree by the examination of the senior class in chemistry. Both these classes had been taught by Mr. Spencer, and did him very great credit.

Session 1855–6.

Report of Council.

In the sixth or highest classes of mathematics and physics, conducted by the Rev. Wm. Cook, the Council are informed that the class for mechanics, though not large, was a very efficient one; that the pupils were engaged with† Newth's larger treatise, which they requested to have instead of the smaller one formerly used, and with which they were not satisfied; that there was a great ambition amongst them to work the more difficult problems, and that they succeeded very well. Once a week experiments were given in mechanics, hydrostatics, pneumatics, heat and electricity.

Mr. Cook's class for pure mathematics learned: geometry —Euclid, books VI. and XI.; plane trigonometry; spherical trigonometry with applications to astronomy; algebra—expansion of functions of one variable into series, binomial theorem, exponential and logarithmic series, convergency of series, algebraic geometry including conic sections, cycloid,

---

* Viz., Newth's "Statics" in place of Snowball's "Mechanics."

† Newth's "Mechanics" instead of Newth's "Statics."

&c., with a few theorems in the differential calculus. The class is reported to have *averaged* better than any of its predecessors, to have taken a lively interest in the work, and to have had only two boys whose progress failed to give entire satisfaction. The ages of the four prizemen in these classes were respectively 15¾, 17, 15½, and 16.

Examiner's Report.

In Mr. Spencer's two classes of natural philosophy, though some of the boys did fairly well, the questions were not generally so well answered as I have seen them in former years.

In the sixth and fifth chemistry, the boys did not seem to me to do so well as might have been expected; not so well as like classes in former years.

Note.

The first prizeman in the VI., pure and applied mathematics, the late Jacob Stiebel, was afterwards, in 1858, Andrews Scholar of University College, and stood second in mathematical honours at matriculation in 1859, and at first B.A. in 1860, the first place on both occasions being obtained by Mr. Dale, of Trinity College, Cambridge, third wrangler in 1862.

The first prizeman in the lower VI., experimental physics, and in the senior class of chemistry was W. Lant Carpenter, subsequently B.A. and B.Sc. London, and first in chemistry at the examination for the latter degree.

Session 1856–7.

Examiner's Report.

I looked at the papers of only two boys in the examination of the chemistry classes under Mr. Spencer. They happened to be the two boys who gained the prizes in the fifth class. I scarcely need say that I found their answers good.

Note.

The Rev. P. Magnus, late Andrews Scholar of University College, and B.A. and B.Sc., London, with honours in various subjects, was one of the two equal prizemen.

Session 1857–8.

Examiner's Report.

Mr. Cook examined the VI. class in natural philosophy upon the propagation of waves of air, and musical vibrations; and also upon the phenomena of steam and congelation, and latent heat, and upon the hygrometer.

Mr. Spencer gave the lower VI. class in natural philosophy a short examination (five questions) upon the history of the steam engine. I saw some of the papers, and, as far as I was able to judge, the boys seemed to understand the subject.

Mr. Spencer printed questions for the examination of his three classes of chemistry. I saw the work of some of the boys in the VI. and V. classes, and, so far as I was able to judge, I thought it well done. Mr. Spencer found himself warranted in awarding two prizes in each class, and in mentioning with praise rather a large number of the boys in each.

Note.

The first place in Mr. Cook's examination was gained by W. Rutt, now C.E.; the second place by Mr. Magnus.

The first place in Mr. Spencer's class fell to Ll. D. Bevan (now the Rev.), afterwards University (Lond.) exhibitioner in English; B.A. in 1863, with first class in moral philosophy; and LL.B. in 1866, with first class in principles of legislation.

The second prizeman in the fifth class of chemistry was H. C. Watson, afterwards scholar of Trinity College, Cambridge, and eighth wrangler in 1865; late Vice-principal of Elizabeth College, Guernsey

The first prizeman in the fourth class of chemistry was H. G. Howse, now M.B. and B.S., London, and exhibitioner, medallist and scholar of the University; and demonstrator in anatomy at Guy's Hospital.

Session 1858–9.

Examiner's Report.

In applied mathematics, the VI. class, under Mr. Cook, passed a hard examination in statics, and also in the elements of dynamics and of hydrostatics.

In experimental natural philosophy, Mr. Spencer gave a short and good examination on the mechanical properties of the atmosphere (barometer, air pump, &c.), and on electricity. I did not see many of the papers, but those I saw were good.

Note.

The first prize in Mr. Cook's VI. class was obtained by Mr. H. C. Watson; the third by N. E. Hartog, afterwards B.A., London, with exhibition in Latin, scholarships in mathematics and classics, and prizes in French, German, and animal physiology; more recently scholar of Trinity College, Cambridge; and in 1869 senior wrangler.

The second prizeman in Mr. Spencer's class, J. E. Carpenter, became scholar of University of London in logic and moral philosophy; and M.A. in 1866 in the same branch, and "deserving of medal."

Session 1859–60.

Report of Council.

Preparatory to the second term of the current session the Council, on the application of the Headmaster, made arrangments for an improved and more extensive system of instruction in chemistry. They have caused a room to be fitted up with suitable apparatus for teaching practical chemistry; and Mr. George Carey Foster, assistant to Dr. Williamson in the conduct of the Birkbeck laboratory of analytical chemistry in the college, has been engaged by Professor Key, to instruct a class during the present session. The applicants for permission to attend it have been so numerous that all could not be admitted. The nature and the mode of instruction, and especially the extent of accommodation, required that the class should be of limited size; and Professor Key has made a selection of about 30.* He has been governed in his choice by the convenience of pupils according to their engagements in other classes, by their character for good conduct, and by the probability that from their previous acquirements in the subject they would duly profit by the teaching.

Headmaster's Report.

To the practical class in chemistry none were admitted who had not already received theoretic instruction in the subject from Mr. Spencer. Of course, where such a class meets but twice a week, the progress must be comparatively small; yet the success which followed Mr. G. C. Foster's exertions may be regarded as a favourable augury, and although he himself was obliged to resign the duties at the end of the year, as I had been led to expect from the very outset, in consequence of an engagement abroad, I have had the good fortune to replace him by a highly qualified successor in Dr. Russell.

Communication from Professor G. Carey Foster, B.A., F.R.S. (December 1870).

My class of practical chemistry in University College School began, I believe, in February 1859.

The course of instruction was of this kind: At the beginning of each lesson, each *pair* of boys was supplied with certain materials and apparatus, and, as soon as they were all in their places, I described, as fully as I could, the experiments I wished them to make, but without telling them what result to expect. When they had done this, I made them examine, during the same or the next lesson, the products of the operations they had gone through. The operations given at first were chosen so as to give an idea of the way in which chemical action occurs in a few typical cases, and especially so as to make the boys see that the elements with which they began could be traced through a whole series of changes, and could be recovered with their original properties at the end. Gradually I led them on to easy cases of qualitative analysis.

Throughout the course I purposely avoided the use of any text-book, as I specially wished that the knowledge the boys got in the class should be, as far as possible, the result of *their own* observations and experiments.

I went abroad in the autumn of 1859, so that I had the class only two terms.

I remember that I was well satisfied with the progress made by several of the boys, and that Dr. Russell, who succeeded me, told me he found that they knew more than he expected they would have learned in the time.

Communication from Dr. Russell (December 1870).

I had charge of the class of practical chemistry in University College School three years. The class consisted of about 20 boys; it met for one hour twice a week. The boys were expected to have attended or be attending a course, also given in the school, of theoretical chemistry, and consequently to have some general knowledge of the science.

---

* More correctly 20 or 24.

In my class they began with the preparation of oxygen, and simple experiments illustrating its properties, putting together for themselves the apparatus necessary. From oxygen they went on to hydrogen, and the other most important non-metallic elements, experimenting with them and their principal compounds. They were taught the reactions for the most common acids, and the analysis of solutions containing several acids.

A few of the boys remained long enough, and were sufficiently advanced to study the properties of the metals, and to analyse a solution containing acids and bases, but this was rather the exception than the rule.

The boys were interested in their work, and behaved well; and my impression is that, considering the small amount of time devoted to the subject, the class was decidedly successful.

Session, 1859–60.

Examiner's Report.

The examination of Mr. Spencer's fifth class in natural philosophy was short and easy, but in my judgment a good and sensible one, sufficient to test the knowledge of the boys, and not so hard as to discourage them.

The questions were upon specific gravities, the pressure of fluids, and the construction of the air pump and the barometer. The upper boys did thoroughly well, and several others fairly well.

Note.

The prizeman of division A., H. A. Smith, now of St. Bartholomew's, matriculated ninth in honours.

The first prizeman of division B., A. W. Harding, gained a medical exhibition at University College in 1867, and graduated as B.A., Lond., with a first class in moral philosophy, in the same year.

Session, 1862–3.

Headmaster's Report.

It was thought that to place in different hands the theoretical instruction and the practical instruction on chemistry, was detrimental to good progress. I have, therefore, entrusted all our chemical classes to Mr. C. H. Gill, as well as those of natural philosophy, treated experimentally.

Dr. Williamson bears testimony that Mr. Gill's success in imparting knowledge of the elementary principles of physics and chemistry is such as he has seldom seen equalled and scarcely ever surpassed; also that he is a truly admirable worker at experimental operations.

Session, 1863–4.

Headmaster's Report (Nov. 7, 1863).

Mr. Gill attends from 2.15 to 4 twice a week, Mondays and Fridays. From 2.15 to 3 on Mondays he meets a double class of some 50 boys, and gives them a lecture on theoretical chemistry. On Fridays, one half of this class meet at the same time for an examination, conducted in writing, and Mr. Gill employs an hour or so out of school time in the separate correction of these exercises. The other half of his theoretical class devote or will devote an hour on both Monday and Friday (from 3 to 4) to practical chemistry. I have said *will* devote, because he finds it desirable at the outset to give these boys an extra dose, so to say, of theoretical chemistry, without which they can do but little in practical chemistry.

On Tuesdays and Thursdays the classes of natural philosophy meet, one from 2.15 to 4, the other from 3 to 3.45. These two classes, each consisting of some 25 boys, stand on the same level, and must not be considered as a senior and junior.

In both classes, whether for chemistry or natural philosophy, Mr. Gill takes for his guidance the demands of the University of London.

It must not be forgotten that over and above Mr. Gill's classes, there is the class of mathematical physics conducted by Mr. Spencer, which meets every one of our four afternoons, from 1.30 to 2.15.

Afternoon Period.	M. F.				T. Th.		
	1.	2 M.	2 F.	3.	1.	2.	3.
Mr. Spencer	Applied mathematics.	- - -	- - -	- - -	Applied mathematics.		
Mr. Gill	- - -	- - -	- - -	- - -	- - -	V^a Experimental Physics.	V^b Experimental Physics.
Ditto	- - -	V^a & V^b Chemistry (lect.)	V^b Chemistry (examination.)	V^a Practical Chemistry.			

Session 1864–5.

Headmaster's evidence before Schools Inquiry Commission, 3rd May, 1865.

2995. With regard to the physical sciences, do you give any instruction in them?—We do.

Will you state of what description?—I will take chemistry. We have two classes in chemistry. I suppose we have as many as 60 boys learning chemistry, learning it theoretically first; but we have a class of 24 boys learning it practically, and they have a laboratory of their own, and do the things as well as talk about them. They make the experiments under the eye of their teacher. I have reason to believe that they become fairly proficient. We limit the amount. We do not let them go far into it. We rather study a thorough knowledge of the little they deal with. They do get a practically useful knowledge of chemistry.

3041. What do you consider to be the practical value of the study of physical science for a general commercial education?—If a subject like botany is included, I should say it does but very little good indeed.

Chemistry for instance?—Well, there, I think there is a practical advantage in the study of even a little chemistry; it is so much connected with life. All our manufactures at the present day are becoming scientific manufactures.

3053. At what age do your boys begin the study of physical science?—Our rule is this, that they shall not commence that study till they are thoroughly acquainted with fractions, vulgar and decimal, and that brings them up to the age of 13 or 14.

Do they begin the study of chemistry so early as that?—Sometimes. The young man I spoke of, Numa Hartog, did.

Apart from the simple utility of science, what place do you assign to science as an element of knowledge for educational training?—I think that chemistry is really a very valuable thing for training the reasoning powers as well as the powers of observation, but the reasoning powers particularly. As to botany, as generally taught, I look upon it as a very large ugly spelling book.

Session, 1864–5.

Report of Council.

Of the mathematical and physical departments, the reports are quite favourable, especially the class of physics conducted by Mr. Gill, which appears to be alike popular and effective.

Session, 1865–6.

Headmaster's Report.

The charge of the highest class in natural philosophy, viz., that of applied mathematics, has been entrusted to Mr. J. J. Walker, a very distinguished mathematical student of Trinity College, Dublin, and the author of some

original papers on applied mathematics, especially one on the interesting subject of the secondary rainbow formed by reflection upon water.

Report of French Commissioners.

École (Secondaire) annexée au Collége de l’Université.
[Visited in Lent Term, 1866.]

Ce qui nous a le plus surpris et charmés, dans notre visite à l’école du Collége de l’Université, c’est l’enseignement de l’économie politique, qui s’y donnait alors. Nous nous défiions de cette promesse du prospectus; nous pensions que l’accès de cette science, ouvert à des enfants de 14 ou 15 ans, était un peu prématuré. Une leçon, faite en notre présence par M. Hodgson,* a dissipé nos préventions, et nous a montré que, avec du tact uni à beaucoup de savoir et d’esprit, un professeur peut initier très-utilement aux éléments de la science économique les enfants même de cet âge.

Trente-six élèves éaitent réunis dans un amphithéâtre. Le professeur faisait non pas une leçon suivie, mais une piquante conversation, qu’il dirigeait avec habilité et soutenait avec une *humour* qu’on aurait pu appeler l’esprit du bon sens. Des exemples familiers, des observations aussi amusantes que vraies, excitaient à la fois et délassaient l’attention. Le maître s’interrompait sans cesse par des questions auxquelles les élèves s’empressaient de répondre. Il amenait de petites controverses qu’il faisait discuter contradictoirement, et dont il mettait aux voix la solution. Tous ces jeunes visages, tour-à-tour sérieux et souriants, étaient sous le charme de la parole et obéissaient à toutes ses impulsions. Au sortir de la leçon, nous avons conseillé au principal un nouveau genre de punition pour les élèves dont il serait mécontent, c’est de les priver d’une séance du cours d’économie politique.

* * * *

Parmi les classes de science dans l’école, nous citerons celle de mathématiques appliquées, faite par le professeur Walker. Vingt élèves étaient présents. Il s’agissait du centre de pression en hydraulique. Le professeur avait fait sa figure au tableau; la démonstration n’était, bien entendu, que purement élémentaire. Au moment où nous sommes entrés, une discussion animée s’était engagée entre les élèves et le professeur. Pourquoi, d’abord, toutes les pressions partielles seraient-elles réunies dans le centre de pression? Ce centre, où serait-il dans le rectangle? Où serait-il dans le triangle, avec la base en bas, ou bien renversé? Tout cela formait le sujet d’un feu croisé de suppositions de la part des élèves, et d’objections de la part du professeur. De cette façon, un sujet aride pour des enfants prenait, sous la forme d’une conversation familière, une allure de plus intéressantes. Les élèves jouaient, pour ainsi dire, aux échecs avec le professeur.

Une autre classe, celle de physique expérimentale, nous a paru excellente par le choix des expériences et par l’habileté que montrait le professeur, M. Gill, à faire raisonner les élèves sur les faits. Il traitait, ce jour-là, de la lumière, et les volets fermés, il faisait l’expérience bien connue des miroirs paraboliques. Par quel moyen le feu placé dans l’un des foyers allumait-il un combustible placé dans l’autre? les élèves se sont chargés de l’expliquer au professeur. Lui, il écoutait, il feignait l’ignorance, trouvait des objections, et petit-à-petit, une erreur après l’autre a été écartée, et finalement un des jeunes auditeurs a dit le dernier mot. C’était le système de M. Hodgson et du professeur Walker, transporté sur un autre terrain. Du reste, dans cette classe nous avons vu recueillir des rédactions sur la leçon précédente.

Session 1866–7.

The following details respecting the condition of the science classes are extracted from one of the tables furnished to the Schools Inquiry Commission, and printed in their report. Vol. X., p. 226.

Session 1866–7.	Statistics of the whole School.		Statistics of First Class.				Statistics of Lowest Class.			
Subject.	Number of Boys learning each Subject.	Number of Classes into which the Boys are formed.	Number of Boys in the Class.	Aggregate of Time per Week given to each Subject.	Average Age at close of Session.	Session 1866–7. Work of Third or Midsummer Term.	Number of Boys in the Class.	Aggregate of Time per Week given to each Subject.	Average Age at close of Session.	Session 1866–7. Work of Third or Midsummer Term.
				HOURS.	Y. M.			HOURS.	Y. M.	
Mathematics:										
Pure	177	11	10	6	15 10	Todhunter’s Conics, chaps. 1–3, 5, 6, 9; Todhunter’s Trigonometry, chaps. 1, 3–6, 10, 13–15; Todhunter’s Euclid, xi., 1–21; and about 150 deductions. Elements of Statics and Dynamics, Hydrostatics, and Optics, with the construction and theory of the common machines and instruments. Instruction chiefly *vivâ voce*; Text-book, Galbraith and Haughton.	23	6	15.8	Euclid, books 1, 2; deductions to first book; algebra to simple equations.
Applied	10	1	10	3	15 10					
Physics	69	2	17	1½	15 9	Light and Radiant Heat, and Elements of Acoustics; instruction *vivâ voce*.	52	1½	15.4	Elements of hydrostatics and pneumatics; determination of the specific gravity of solids, liquids, and gases.
Chemistry, theoretical.	61	2	9	1½	16 0	Preparation and properties of some of the most common metals and their compounds; instruction *vivâ voce*.	52	1½	15.7	Preparation and properties of some of the non-metallic elements; the compounds formed among themselves; their relations by weight.
Chemistry, practical.	15	1	15	2	15 7	Preparation by the boys themselves of some of the non-metallic elements and their compounds; testing for common acids, single and mixed.				

---

* W. B. Hodgson, LL.D., member of the council of the college, gave his services during this session in instructing provisionally the class of social science in the school.

Communication from Mr. C. H. Gill, F.C.S.—
(*December* 1870.)

During the five years in which I had charge of the classes of experimental science, 1863–4 to 1867–8 inclusive, instruction was given in the following subjects:—

1. *Elementary Chemistry*, taught by means of lectures with full experimental demonstrations; monthly examinations, in which many numerical questions always found place; and daily written exercises on the preceding lecture.

There were two classes for this subject, each meeting twice a week. In the first, any boy wishing to commence the subject was received, provided he had a competent knowledge of arithmetic; while to the second only those who had previously acquired a firm ground-work of chemical facts, either in the school itself or elsewhere, were admitted.

Most of the boys in the second or senior class, with a few of those from the junior class, also attended a class of practical chemistry, which met once a week for two hours. In this most valuable class, the boys themselves individually performed the simpler experiments of demonstration, and acquired an insight into the method pursued in solving questions by means of experiment.

2. *Experimental Physics*, taught in the same way as chemistry, and with careful exclusion of mathematical formulæ. The subjects taken were:—

Elementary dynamics and statics, includiug hydrostatics and pneumatics; so treated as to lead the boys to construct the formulæ relating to the simpler cases for themselves from the results of experiments exhibited or described.

Elements of heat, including the method for determining the constants and calculations relating to specific heat, &c.

Elements of light and radiant heat, including nature of light, simple laws governing its transmission, formation of images in plane and curved mirrors, refraction of light, index of refraction, formation of images by lenses, compound nature of light, nature of colour, &c.

Elements of sound, and, when time could be found, some portions of electricity and magnetism.

These subjects were spread over two years, each boy following them in the above order, and receiving two lessons of three quarters of an hour weekly.

My choice of subjects was governed by the requirements of the University of London.

The four periods of three quarters of an hour each devoted to lectures, the like time given to experimental physics, and the two hours for practical chemistry, amount to eight hours per week employed in science teaching.

The effect of the study of science in each year or even in any number of years, admits of no exact measurement: it must be sought in the capabilities of the boys so prepared. All that I can add on this point is that many boys from my classes have since elected to make science a life calling, and that no inconsiderable number have achieved University distinction.

APPENDIX TO PART I.

Containing Statistical Tables, accompanied by remarks and explanations.

Table No. 1.

1. *Applied Mathematics.*

The class of applied mathematics dates from 1835–6, and was for three years under Mr. W. Wright, B.A., former scholar of Trinity College, Cambridge, afterwards LL.D., and headmaster of the Colchester Grammar School.

Mr. Wright was followed by the Rev. Wm. Cook, M.A., of Trinity College, Cambridge, who had charge of the class for 22 years.

From April 1860 to the end of the session, the class was conducted by Dr. T. Archer Hirst (afterwards F.R.S., and professor successively of mathematical physics, and of pure mathematics in University College), who continued in the school for the four following sessions as principal master in pure mathematics.

From 1860–1 to 1864–5, inclusive, the teaching of applied mathematics was in the hands of Mr. J. A. Spencer, B.A., London, and Mathematical University Exhibitioner.

Mr. J. J. Walker, M.A., of Trinity College, Dublin, succeeded Mr. Spencer in session 1865–6.

The following text-books have been used in succession:—

(1.) Whewell's "Mechanical Euclid."
(2.) Snowball's "Mechanics."
(3.) (1850–1 to 1854–5) Newth's "Elements of Mechanics and Hydrostatics."
(4.) (1855–6 to 1864–5) Newth's "Mechanics."
(5.) (1862–3 to 1866–7) Galbraith's "Optics."
(6.) (1865–6, 1866–7) Galbraith and Haughton's "Mechanics" and "Hydrostatics."

The book now sanctioned, though the instruction is principally oral, is:

(7.) Newth's "First Book of Natural Philosophy."

2. *Experimental Physics.*

It is not clear whether, under Mr. Wright, there was any experimental teaching in the sixth class of natural philosophy, or not.

The only classes which were undoubtedly experimental, up to the close of 1838–9, consisted solely of boys who did not learn Greek.

In the following session, Mr. Cook's second year, natural philosopny ceased to be a mere alternative for Greek, and became an integral, though not a compulsory, part of the curriculum.

For two or three sessions at the least, Mr. Cook gave one third only of his sixth class's time to applied mathematics (viz., 1½ hours per week), whilst two-thirds were devoted to experimental teaching. During that time, although the mathematical and experimental divisions of the class consisted of the same or very nearly the same boys, they were examined as distinct classes and received for each branch separately prizes and "honourable mentions."

As the boys who, in subsequent years, came up to the sixth class, had already gone through an experimental course, the proportion of time given by Mr. Cook to experimental teaching in that class was very much reduced. In 1855–6 only one lesson per week was so bestowed. Accordingly, in most years, the two subjects were no longer separated in Mr. Cook's examinations, and prizes and "mentions" came to be awarded on the aggregate of marks obtained in both branches combined. Mr. Cook was followed in this practice until 1863–4 by Mr. Spencer.

By the side of the sixth class, in most years, ran a lower sixth, consisting of boys of the same standing, but of inferior attainments. This class was conducted for many years by Mr. Spencer, and was purely experimental.

The fifth and fourth classes of natural philosophy were likewise under the charge of Mr. Cook and Mr. Spencer. Between the years 1838 and 1844, Mr. J. H. Webster, B.A. (now M.D.) of Jesus College, Cambridge, and the Rev. F. W. Ellis, M.A., of Trinity College, Cambridge (afterwards chaplain in Bengal), successively assisted in the teaching.

The following is the list of text-books arranged in chronological order:—

(1.) The Useful Knowledge Series "Introduction to Natural Philosophy" } used contemporaneously.
(2.) Webster's "Elements of Physics" }
(3.) Carpenter's "Natural Philosophy for Beginners" } used contemporaneously.
(4.) Carpenter's "Mechanical Philosophy" }
(5.) (1847–8 to 1851–2) Peschel's "Physics," Vol. I.
(6.) (1852–3 to 1855–6) Lardner's "First Course of Natural Philosophy" (Mechanics, Hydrostatics, Sound, Optics).
(7.) (1853–4) Lardner's "Second Course" (Electricity, Heat, Magnetism).
(8.) 1856–7) Lardner's "Mechanics."
(9.) 1857–8) Lardner's "Electricity."
(10.) Lardner's "Steam Engine."
(11.) (1857–8 to 1862–3) Lardner's "Natural Philosophy for Schools."

The science classes were remodelled in 1863–4, and were then placed under the charge of Mr. C. Haughton Gill, F.C.S., who has since published a text-book entitled "Chemistry for Schools."

On Mr. Gill's resignation, at the close of 1867–8, the senior class of natural philosophy was assigned to Mr. Walker, who already gave iustruction in applied mathematics, and the junior class (chemical physics) to Mr. T.

A. Orme, F.C.S., whose recently published "Introduction to the Science of Heat" is in use as text-book.

3. *Astronomy.*

The class of astronomy was formed in 1866–7, on Mr. Walker's suggestion, and since the beginning of the following session has been conducted by him. During the first year it was taken provisionally by other masters.

4. *Chemistry.*

The first matriculation examination of the London University, in which chemistry has been from the first one of the compulsory subjects, was held in October 1838, and, probably with a view to direct preparation for future examinations, a class of chemistry was formed in University College School in 1839–40. The class was under Mr. Cook's care. Dr. Reid's "Chemistry" was used as text-book, and experiments were performed with apparatus furnished by the college.

The subject was, however, discontinued until 1847–8, when a class was formed under Mr. Spencer's charge. In the following year Fownes' "Chemistry" (2nd edition) was introduced as text-book, and continued in use until the end of 1862–3.

The earliest date at which boys began to matriculate from the school itself, without passing into the college, was July 1847.

The theoretical instruction in chemistry remained in Mr. Spencer's hands until the general re-construction of the science classes in 1863–4. From that date the theoretical classes and the practical class have been under the same master, for the first five years under Mr. Gill, and for the last two years under Mr. Orme, and the teaching has been mainly oral. In individual cases, the text-books of Professor Williamson or Professor Roscoe were sometimes recommended: and, since the date of their respective publication, Barff's "Introduction to Scientific Chemistry" and Gill's "Chemistry for Schools" have been in more general use, the former for the junior, and the latter for the senior class.

5. *Practical Chemistry.*

A class of practical chemistry was formed for the first time in Lent Term, 1859, under Mr. G. Carey Foster, B.A. Lond., now F.R.S., and Professor of Physics in University College.

He was succeeded in the following session by Dr. Russell, now Lecturer on Chemistry and Practical Chemistry at St. Bartholomew's, who taught the class for three years.

Mr. Gill had the care of the class during the six following sessions, and for the last two sessions it has been in the hands of Mr. Orme.

TABLE No. I.

Natural Philosophy Classes.	No. of Classes or Divisions of Classes.	Applied Mathematics. Class VI.		Experimental Physics. Class VI.		Astronomy. Class V.		Experimental Physics. Class V.		Experimental Physics. Class IV.	
Session.		A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
1832	—	—	—	—	—	—	—	—	—	—	—
1832–3	—	—	—	—	—	—	—	—	—	—	—
1833–4	—	—	—	—	—	—	—	—	—	—	—
1834–5	—	—	—	—	—	—	—	—	—	—	—
1835–6	2	—	3	—	—	—	—	—	3	—	—
1836–7	2	—	4	—	—	—	—	—	4	—	—
1837–8	3	—	7	—	—	—	—	—	5	—	8
1838–9	3	—	4	—	—	—	—	—	3	—	4
1839–40	4	—	11	—	5	—	—	—	9	—	8
1840–1	4	—	4	—	3	—	—	—	4	—	5
1841–2	3	—	8	—	5	—	—	—	4	—	—
1842–3	5	—	5	—	5	—	—	—	5 + 2	—	8
1843–4	5	—	7	—	7	—	—	—	4 + 12 + 3	—	—
1844–5	4	—	3	—	3	—	—	—	7 + 8	—	—
1845–6	4	—	8	—	4	—	—	—	13 + 4	—	—
1846–7	3	—	4	—	4	—	—	—	2	—	—
1847–8	4	—	5	—	5	—	—	—	3 + 11	—	—
1848–9	5	—	3	—	3	—	—	—	9 + 3 + 5	—	—
1849–50	5	—	4	—	4	—	—	—	5 + 3	—	3
1850–1	5	—	4	—	4 + 8	—	—	—	3 + 6	—	—
1851-2	5	—	2	—	2 + 10	—	—	—	7 + 3	—	—
1852–3	5	—	9	—	9 + 10	—	—	—	7 + 5	—	—
1853–4	5	—	6	—	6 + 9	—	—	—	3 + 3	—	—
1854–5	5	—	2	—	2 + 12	—	—	—	3 + 7	—	—
1855–6	5	—	5	—	5 + 11	—	—	—	2 + 11	—	—
1856–7	5	—	9	—	9 + 10	—	—	—	2	—	2
1857–8	5	—	7	—	7 + 11	—	—	—	9	—	10
1858–9	5	—	9	—	9 + 12	—	—	—	12	—	5
1859–60	5	—	9	—	9 + 9	—	—	—	11	—	6
1860–1	4	—	7	—	7	—	—	—	6	—	5
1861–2	4	—	4	—	4	—	—	—	5 + 9	—	—
1862–3	4	—	6	—	6	—	—	—	9 + 5	—	—
1863–4	3	—	4	—	—	—	—	? + ?	12	—	—
1864–5	3	—	5	—	7	—	—	—	10	—	—
1865–6	3	—	5	—	10	—	—	—	10	—	—
1866–7	4	10	5	17	9	16	4	51	11	—	—
1867–8	5	9 + 10	6 + 4	24	7	15	3	46	8	—	—
1868–9	4	12	4	18	6	9	2	23	8	—	—
1869–70	4	10	4	32	10	16	3	20	4	—	—

TABLE No. I.—*continued.*

Chemistry Classes. Session.	No. of Classes or Divisions of Classes.	Practical. Class VI. A.	Practical. Class VI. B.	Theoretical. Class VI. A.	Theoretical. Class VI. B.	Theoretical. Class V. A.	Theoretical. Class V. B.	Theoretical. Class IV. A.	Theoretical. Class IV. B.
1832 - - -	—	—	—	—	—	—	—	—	—
1832–3 - - -	—	—	—	—	—	—	—	—	—
1833–4 - - -	—	—	—	—	—	—	—	—	—
1834–5 - - -	—	—	—	—	—	—	—	—	—
1835–6 - - -	—	—	—	—	—	—	—	—	—
1836–7 - - -	—	—	—	—	—	—	—	—	—
1837–8 - - -	—	—	—	—	—	—	—	—	—
1838–9 - - -	—	—	—	—	—	—	—	—	—
1839–40 - - -	1	—	—	—	5	—	—	—	—
1840–1 - - -	—	—	—	—	—	—	—	—	—
1841–2 - - -	—	—	—	—	—	—	—	—	—
1842–3 - - -	—	—	—	—	—	—	—	—	—
1843–4 - - -	—	—	—	—	—	—	—	—	—
1844–5 - - -	—	—	—	—	—	—	—	—	—
1845–6 - - -	—	—	—	—	—	—	—	—	—
1846–7 - - -	—	—	—	—	—	—	—	—	—
1847–8 - - -	1	—	—	—	—	—	13	—	—
1848–9 - - -	2	—	—	—	10	—	8	—	—
1849–50 - - -	2	—	—	—	9	—	6	—	—
1850–1 - - -	2	—	—	—	11	—	7	—	—
1851–2 - - -	2	—	—	—	8	—	7	—	—
1852–3 - - -	2	—	—	—	10	—	6	—	—
1853–4 - - -	2	—	—	—	8	—	6	—	—
1854–5 - - -	2	—	—	—	13	—	10	—	—
1855–6 - - -	2	—	—	—	14	—	9	—	—
1856–7 - - -	2	—	—	—	11	—	15	—	—
1857–8 - - -	3	—	—	—	13	—	10	—	8
1858–9 - - -	3	15	?	—	10	—	6	—	—
1859–60 - - -	4	—	3+6	—	10	—	5	—	—
1860–1 - - -	5	—	1+7	—	7	—	6	—	5
1861–2 - - -	5	—	1+5	—	4	—	5+5	—	—
1862–3 - - -	3	—	4	—	9+4	—	—	—	—
1863–4 - - -	3	—	8	—	—	?+?	13	—	—
1864–5 - - -	3	—	3	—	5	—	9	—	—
1865–6 - - -	3	—	5	—	6	—	10	—	—
1866–7 - - -	3	15	3	8	3	55	11	—	—
1867–8 - - -	3	17	7	14	8	49	15	—	—
1868–9 - - -	3	9	4	16	11	37	9	—	—
1869–70 - - -	3	16	8	15	7	41	17	—	—

The A. column gives the number of boys in each class at the end of the session, at which time the principal examination takes place.

The B column gives the number of boys in each class who in each year obtained prizes or honourable mentions on the aggregate results of the three terminal examinations.

Generally speaking, it is necessary to obtain at least half the maximum of marks, in order to be entitled to a "mention."

The spaces are left blank where there is no exact information as to numbers.

TABLE No. II.

Showing the NUMBER of FORMER PUPILS of UNIVERSITY COLLEGE SCHOOL, to whom prizes have been awarded in the Natural Philosophy classes, and gold or silver medals in the Chemistry classes, of University College, in each year since 1836.

Session.	Applied Mathematics. Extra Senior Class.	Applied Mathematics. Senior Class.	Applied Mathematics. Junior Class.	Experimental Physics.	Chemistry. Gold Medals.	Chemistry. Silver Medals.
1836–7 - -	—	—	—	1	—	—
1837–8 - -	—	1	—	—	—	—
1838–9 - -	1	—	1	—	—	—
1839–40 - -	—	—	1	—	—	—
1840–1 - -	—	—	3	—	—	—
1841–2 - -	—	2	1	1	—	—
1842–3 - -	—	—	1	1	—	—
1843–4 - -	—	1	1	2	—	—
1844–5 - -	—	2	2	—	—	—
1845–6 - -	2	1	—	—	—	—
1846–7 - -	—	—	1	—	—	—
1847–8 - -	—	1	1	—	—	—
1848–9 - -	—	1	—	—	—	—
1849–50 - -	—	—	—	—	—	—
1850–1 - -	—	—	—	—	—	—
1851–2 - -	—	—	—	—	—	2
1852–3 - -	—	—	—	1	1	—
1853–4 - -	—	1	—	—	—	—
1854–5 - -	—	—	2	—	—	—
1855–6 - -	—	1	—	—	2	—
1856–7 - -	—	1	2	—	—	—
1857–8 - -	—	1	—	1	—	1

TABLE No. II.—*continued.*

Session.	Applied Mathematics.			Experimental Physics.	Chemistry	
	Extra Senior Class.	Senior Class.	Junior Class.		Gold Medals.	Silver Medals.
1858–9 - -	—	—	2	—	—	—
1859–60 - -	—	—	2	3	3	—
1860–1 - -	—	2	2	1	—	—
1861–2 - -	—	1	1	1	—	—
1862–3 - -	—	1	1	1	1	1
1863–4 - -	1	—	1	1	—	1
1864–5 - -	—	1	2	—	1	—
1865–6 - -	—	1	2	1	—	—
1866–7 - -	—	—	3	—	1	—
1867–8 - -	—	1	—	—	—	—
1868–9 - -	—	—	—	1	—	—
1689–70 - -	—	—	—	1	1	—

The results of the teaching in University College School are naturally best seen in the success of its pupils in the college to which it is attached, and for which, in accordance with the intention of its founders, it acts as a nursery.

The above table has, therefore, been drawn up for the purpose of showing (with approximate accuracy) the number of prizes obtained by former pupils of the school in the science classes of University College.

Of certificates, as distinguished from prizes, corresponding in principle to the "honourable mentions" or "commendations" of the school prize lists, no account has been taken.

TABLE No. III.

The following table contains, in its first column, the name of every boy who, within the seven years, 1863–4, 1869–70, obtained a prize in any one of the four senior science classes, viz., applied mathematics (A.M.), senior experimental natural philosophy (E.P.), senior theoretical chemistry (C.), or practical chemistry (P.C.).

The second column gives the session, and the third column the class or classes in which the said prize or prizes were obtained.

The fourth column specifies the various additional subjects in which prizes ("commendations" or "honourable mentions" not being taken into account) were won by the same boy in the same session.

The fifth column gives the sum total of the prizes obtained.

The sixth column shows the College and University distinctions subsequently gained, including the London matriculation "honours," which, in some instances, preceded by a few weeks the winning of the school prize.

To explain the significance of the table, it must be stated that, in University College School, (1) the number of subjects taught is unusually great; (2) the boys are classed separately and individually for each subject; and (3) prizes are given yearly in each class.

The proportion during the past seven years has been three classes and four prizes to seven boys.

The curriculum of the upper school (as distinguished from the junior school or classes for beginners) extends over six (or seven) sessions or years, and is adapted to prepare boys by the end of the session in which they complete their sixteenth year, for passing the matriculation examination of the University of London and entering as students of University College.

The present number of pupils in the school is (Dec. 1870) 442, [increased to 500, Feb. 1871.]

The object of this table is to show that science teaching forms an integral and not an incidental part of the school curriculum; that the boys who distinguish themselves in the science classes do not form a "caste," or devote themselves to a speciality; that the foremost place in the science classes is sought for with the same interest and eagerness which attend the struggle for corresponding distinction in the traditional and more generally established subjects of school education; and that success in the latter is promoted rather than repressed by simultaneous attention to the former.

1	2	3	4	5	6
Name.	Date of Science Prize.	Subject of Science Prize.	Other Prizes obtained in the same Session.	Total No. of Prizes.	College and University honours. [Matriculation=Matriculation in the University of London.]
Atkinson, R. W -	1865–6	P. C. -	- -	1	Matriculated 1867 from school, prizes in University College, Royal Entrance exhibition (1868), and Royal Scholarship (1870) in Royal School of Mines.
Ball, W. W. R. -	1866–7	A. M. -	Grecian history, mathematics, chemical physics.	4	Matriculated 1867 from school, Mathematical Entrance exhibition in University College (1867), and Mathematical Scholarship (1869), B.A. (1869) with first class in logic, Entrance Scholarship (1869) at Trinity College, Cambridge.
Bishop, W. B. -	1869–70	P. C. -	Roman history -	2	(Still in school.)
Bridgewater, B. J. -	1864–5	P. C. -	Book-keeping, perspective -	3	(In business.)
Bryden, J. -	1867–8	A. M. -	Grecian history, mathematics -	3	Matriculated 1869 from University College.
Cumberbatch, C. W.	1863–4	A. M. -	Greek, English poem -	3	Matriculated 1868 (private study).
Dale, H. F. -	1865–6	A. M. & E. P. -	English essay, social science, chemistry, chess.	6	(In Canada.)
Emanuel, E. J. -	1866–7	A. M., E. P. and C.	French, German, English, English essay, mathematics, natural philosophy (notes).	9	Prizes in University College, matriculated 1868, 22nd in honours.

TABLE No. III—*continued.*

1	2	3	4	5	6
Name.	Date of Science Prize.	Subject of Science Prize.	Other Prizes obtained in the same Session.	Total No. of Prizes.	College and University Honours. [Matriculation = Matriculation in the University of London.]
Frankland, F. W.	1867–8	E. P.	Latin, Grecian, history, mathematics.	4	Mathematical Entrance exhibition in University College 1869, matriculated 1870, second in honours with University exhibition (matriculated at earliest possible age).
Ditto	1868–9	A. M. and C.	Greek, Latin, Grecian history, Roman history, mathematics.	7	
Garlick, G.	1867–8	P. C.	Chemistry	2	Matriculated 1869 (January) from school.
Goodall, F. T.	1863–4	A. M.	French, French essay, English, mathematics, natural philosophy, natural philosophy (notes), arithmetic.	8	Gold and silver medals, and scholarship in Royal Academy, 1869.
Goslett, M. W.	1863–4	C.	Roman history, geography, mathematics.	4	(In business.)
Ditto	1864–5	E.	Natural philosophy (notes).	2	
Greenfield, J. H.	1869–70	E. P.	-	1	Matriculated 1870 from school, 65th in honours.
Higgs, A. H.	1864–5	A. M.	But for absence from chief examination, through illness, would most probably have been first in several classes.		Matriculated 1867 from University College (at earliest possible age), first in honours with University exhibition, classical and mathematical scholarships in University College, 1867, first entrance scholarship at Balliol College, Oxford, 1862, first B.A. London 1869, with University scholarship in Latin.
Jonas, J. J.	1867–8	E. P.	English	2	Matriculated 1869 from University College.
Jones, D.	1867–8	C.	English, Roman history, astronomy.	4	Matriculated 1869 from school, 16th in honours and "worthy of a prize."
Keed, E. A.	1869–70	A. M., C. and P. C.	Latin, English history	5	Matriculated 1870 from school, 11th in honours and "worthy of a prize."
Kenrick, G. H.	1865–6	P. C.	Chemistry	2	Matriculated 1867.
Leverson, B. J.	1869–70	A. M.	Greek, French, reading, mathematics, matriculation mathematics, arithmetic.	7	Entrance mathematical exhibition in University College 1870. [Matriculated Jan. 1871 from school, first in honours with University Exhibition.]
Leverson, J. J.	1868–9	A. M.	German, English history	3	Matriculated 1869 from school, third in honours with University exhibition.
Loddiges, C.	1863–4	C. and P. C.	Mathematics, natural philosophy	4	(In business.)
Lynch, E. M.	1867–8	A. M.	Greek, Latin, mathematics	4	Matriculated 1868 from school, 10th in honours, entrance classical exhibition in University College 1868, and scholarship 1870.
Maunder, E. W.	1865–6	E. P.	Latin, French English history, mathematics, arithmetic.	6	Matriculated 1867 from school.
Muirhead, A.	1864–5	A. M. and C.	Mathematics, chemistry (notes), arithmetic.	5	Prizes in University College 1867, B.Sc. London 1869, with first class in chemistry.
Osler, S. F.	1865–6	E. P.	Chemistry	2	First B.Sc. London 1869.
Pyke, L. E.	1868–9	P. C.	Chemistry	2	Matriculated 1869 from school, 10th in honours, and "worthy of a prize."
Pyke, M. J.	1869–70	E. P.	Mathematics	2	Matriculated 1869 from school.
Rickards, F.	1863–4	A. M.	Greek, Latin, mathematics, book-keeping.	5	Prize in University College 1866, matriculated 1866.
Robson, W. H.	1865–6	A. M. and C.	Latin, English history, mathematics, chess.	6	Matriculated 1866 from school, first in honours with University exhibition.
Rutt, A.	1863–4	C.	German	2	
Scholl, B. F.	1867–8	A. M.	Geography, mathematics, drawing, perspective.	5	
Sewell, E. J.	1865–6	A. M.	Latin, mathematics	3	Matriculated January 1867 from school, 11th in honours, entrance exhibition for combined classics, mathematics, and physics in University College 1866 (October), first B.A. London 1868 with first class in English, appointment in India Civil Service, open competition, 1870.
Symes, E. S.	1866–7	E. P. and P. C.	Chemistry	3	Matriculated 1869 from school, 39th in honours.
Taylor, A.	1863–4	P. C.	-	1	
Thompson, J. W.	1868–9	E. P.	French, impromptu speaking, chemistry.	4	Matriculated 1870 from school, 45th in honours.
Voelcker, G. H.	1869–70	C.	-	1	Matriculated 1870 from school.
Wyatt, F. B.	1869–70	A. M.	Social science, mathematics, arithmetic, drawing, perspective.	6	

REPORT.—Part II.

Account of the present arrangements for Science teaching in University College School.

Michaelmas Term, 1870.

Conditions of Admission, &c.

Boys who have reached the fifth class of arithmetic (below which standard they are disqualified) are required to enter on the first year's course of science, unless their parents object.

The printed programme of the work of the arithmetic classes will show what degree of arithmetical proficiency is implied.*

A few boys, though qualified according to the arithmetical standard, are kept back for a year or so, in consequence of being considered too young.

A few parents object, either on the ground of general indifference to science teaching, or because they think it unsuitable for their own sons, but the number of objections is very small.

Boys who are proved, by their want of success at the monthly examinations or otherwise, to be taking no interest in the science classes, and to be making no progress, are removed from them as soon as there appears no reasonable hope of their continuing to attend with profit.

In the present session, 1870–1, the backward boys of the classes of chemistry and chemical physics will be formed, at the commencement of the second term, into a separate class for "object" lessons (meeting twice a week only, 1½ hours), so as to leave the more advanced boys without impediment to their more rapid progress.

The complete science course comprises normally three years.

First Year.

(Three hours per week.)

Junior class of chemistry, two lessons.
Class of chemical physics, two lessons.

Boys who are preparing for matriculation in the University of London at the end of the current session, but who are not sufficiently advanced for the senior class of chemistry, are allowed exceptionally to attend the class of practical chemistry in their first year. These boys are necessarily not under 15 years of age.

Second Year.

(Six hours per week.)

Class of experimental natural philosophy, two lectures and two exercise lessons. Time, three hours.

Senior class of chemistry, two lessons per week in theoretical chemistry, and one lesson of an hour and a half in practical chemistry. Time, three hours.

Third Year.

(Six hours per week.)

Class of applied mathematics, four lessons. Time, three hours.

Senior class of theoretical and practical chemistry. Time, three hours.

The second and third years' courses, though kept distinct where age permits, are in practice sometimes compressed into one year. In this case the time devoted to science lessons is nine hours per week.

The class of astronomy is an "objet de luxe" attached to the second year's course, but not forming an essential part of it.

The class of applied mathematics numbers at the present time (December 1870) 11 boys; the senior theoretical chemical class, 14 boys; the practical chemistry class, the same number, plus 3 boys out of the junior theoretical class; the astronomy class, 11 boys; and the class of chemical physics and chemistry, 78 boys, to be reduced after Christmas to about 40.

Communication from J. J. Walker, M.A. (Dec. 1870).

On Mr. Gill's resignation of his connexion with University College School at the end of the session, 1867–8, the instruction of the experimental class in the elements of mechanical science, in the outlines of the theories of sound and light, and in the elements of plane optics was entrusted to me, specially with the view of making this class, which would normally be the second year's in the complete science course of University College School, a preparation for the matriculation examination of London University in natural philosophy, and for the class of applied mathematics forming the third year's work in our science course.

In the current session, 1870–1, two lectures in each week are given of an exclusively experimental character, for the purpose of establishing fundamental physical laws, and the properties of the simple machines and instruments; while two other "exercise lessons" are given in an ordinary schoolroom, away from apparatus and models, in which the boys are practised in easy deductions from the fundamental principles established in the experimental lectures, and in the solution of such questions as usually form a part of an examination in the elements of natural philosophy.

The extent to which the subjects taught are carried, and the order in which they are taken up, will be best gathered from the printed programme of the course.*

For the work of the class of applied mathematics, I refer also to the printed programme.†

At the commencement of session 1866–7, a class of elementary astronomy was formed, of which I have had charge. It has been composed each session of those boys who had previously made some progress in the elements of geometry, and who could find time for the subject during their school course in consequence of not being, as a general rule, (subject to exceptions), intended for a university career.

Two lectures weekly are given, a part of each being devoted to descriptive astronomy and star lessons, the constellations most easily observed in the early night at the particular season of the year being sketched, and directions given by which the boys may be enabled to recognize them in a clear sky from the gardens or upper windows of their residences. The remainder of the lecture is devoted to the elements of spherical astronomy with examples drawn from observations supposed to be made on the meridian (so as to obviate any need for the employment of trigonometry); to the explanation of sidereal, apparent, and mean solar time, and the seasons; to the outlines of the elliptic movements of the moon and planets, and to the theory and approximate calculation of eclipses and tides. "Parallax," and "apparent diameter" are explained particularly in connexion with the sun and moon, and the class are led to deduce the approximate dimensions of the solar system from the values of these angles supplied by observers. I term the instruction given "lectures," because no text-book is used: sketches and diagrams are made on the black-board and the teaching is oral, but the boys take their notes, and their attention and comprehension are tested by frequent questions and paper exercises. Generally, in science teaching, I make it a practice not to state anything which can be drawn from the boys themselves by questions more or less "leading" according to the nature of the deduction sought, or by appeal to their own observation and experience; and to interweave with the lessons an outline of the history of the progress of science, fixing the epochs by reference to the leading political or social events with which they have been contemporaneous, as far as likely to be known to the class. At the examination of the natural philosophy class towards the end of the session, selected boys from the class are required to repeat certain experiments and demonstrations with the apparatus with their own hands.

---

* Work of the IV. class of Arithmetic.

1st term.—Decimals and complex vulgar fractions. Metric system.

2nd term.—Square root. Questions on the circle and on rectangular areas and solids generally.

3rd term.—Chain rule. Lessons on the "British Standards" of value, weight, length and capacity. Reduction of weights avoirdupois to troy weights, and *vice versâ*.

Throughout the session, problems.

* Natural Philosophy (Experimental).

1st term.—Properties of rigid matter. Inertia. Force or pressure. Reaction. Equilibrium of three forces. Centre of weight. Stable and unstable equilibrium. Mechanical powers. Newton's first law. Uniform movement. Uniformly accelerated movement. Motion or momentum. Newton's second law. Attwood's machine. Laws of falling bodies. The pendulum and applications. Principles of clock and watch-work.

2nd term.—Newton's third law of motion. Collision and impact. Elasticity. Circular movement and applications. Properties of fluids. Hydrostatic pressure. Archimedes' principle. Specific weight. Simple machines. Atmospheric pressure; engines and instruments depending on it. Principles of the steam engine. Laws of statical friction. Work and energy, with principles of conservation thereof. Molecular forces and capillarity.

3rd term.—Outline of theories of sound and light. Plane mirrors. Images formed by refraction at the surface of water. The prism and dispersion of light. Lenses. Simple optical instruments. Double refraction. Polarization of light.

The lessons to be devoted alternatively to experimental demonstrations or explanations of general principles, and to illustrative exercises and applications of the same.

† Applied Mathematics.

1st term.—Elementary statics and uniformly accelerated rectilinear movement Examples and problems.

2nd term.—Hydrostatics and Pneumatics, as treated by elementary mathematics, with examples and problems. Continuation of work of 1st term.

3rd term.—Geometrical optics. Statical friction. Couples and equilibrium of coplanar forces generally. Guldin's theorems. Impact and collision. Centrifugal force. Projectiles. Rectilinear vibrations. Simple Pendulum. D'Alembert's principle, with easy applications. Problems.

Communication from T. A. Orme, F.C.S.—(*Dec.* 1870.)

Since the beginning of session 1868–9, chemistry and chemical physics have been taught by me. There have been three classes of chemistry, a lower, an upper, and a practical class; and one class of chemical physics. The subjects to which most attention has been paid are the chemistry of the non-metallic elements and of their compounds; heat, and the leading facts of electricity (chiefly voltaic electricity) and of magetism.

The object sought, whilst giving instruction in these subjects, has been rather to teach boys to study scientifically than to impart to them any purely technical information, which would only in a few rare cases be of service to them in after life. The following method has been adopted in order to attain this end:—

The only facts which the boys have been taught are the connected facts of the science to which they relate. No reference has been made to any startling but as yet insufficiently explained phenomenon, unless it tends to throw doubt upon a generally received hypothesis. Very little time has been expended on the study of the merely physical properties of bodies; and the boys have been strongly discouraged from committing such facts to memory. In the junior classes, the boys have been taught to reason from stated phenomena rather than to be perfectly accurate in their memory of them; in the senior classes, they themselves bring about these phenomena in a practical class, and describe them fully in the theoretical one.

Very special attention has been paid to popular fallacies, incorrect expressions, faulty definitions, and baseless theories, such as the following:—that marble is always colder than wood, that there is a difference between a combustible and a supporter of combustion, that mercury is repelled by glass, that certain compounds can be classified chemically under the heads of acid, base, and salt, that there are two electric fluids, and such like.

Text-books have been employed, except in the class of practical chemistry; but merely as books of reference, and the order adopted in them has not been adhered to in the lectures. The boys have learnt chiefly from notes taken during the lecture and from a syllabus of the lectures printed specially for their use.

All the classes have been examined about every five weeks; and in such a way that, while pure and simple "cramming" is rendered almost impossible, a steadily studious boy, who strives to understand every point when it is discussed, and who looks back to past work when present work renders that advisable, has every opportunity afforded him of attaining to the highest place in the class. The class receives no notice whatever of these periodical examinations, and they are held at various intervals, the average being as above stated, about five weeks. The questions are dictated to the boys one by one, every four or five minutes, and the answer to one question is required to be written down before the next is given out. No marks are given for any answer which is not strictly to the point, perfectly accurate, and sufficiently short; marks are deducted for any superfluous words; any apparatus that is mentioned, however simple, has to be sketched by the junior boys, sketched and described by those in the senior classes. After the examination, and on the same day, the proper answers are given to the class; and, at the next meeting, such vague, illogical, or otherwise faulty answers as may have been received are pointed out, and the mistakes corrected. Though but a small per-centage of boys can be induced to work hard at any particular subject, a very large per-centage of them can be taught their own ignorance, so that silly shambling answers diminish in number as the session proceeds. At the final Summer Term Examination, of which notice must be given beforehand, the classes are examined by printed papers; but the questions are required to be answered in the same order as that in which they are given, every boy having by this time learnt pretty well the exact extent of his own knowledge. No marks whatever are given for any answer to a question which is not answered in its proper place.

---

14. MERCHANT TAYLORS' SCHOOL.

10, Leinster Gardens, Hyde Park, W.

DEAR SIR, Feb. 1, 1871.

I AM very sorry that your circular of inquiry on the part of the "Commission of Scientific Instruction" has received no answer from me. It arrived just as Merchant Taylors' School was breaking up for the summer holidays and was mislaid, and so escaped my memory.

I have since resigned the Head Mastership, but I am able to reply to your questions.

There is no provision, at present, for what is termed scientific instruction at Merchant Taylors', though the mathematical reading is very high, and the university distinctions in mathematics have been proportionally great. It is impossible, from want of room, and from other circumstances, to introduce new subjects so long as the school remains in its present confined locality. But I may tell you, for the information of the Commission, that in a scheme which is before the Merchant Taylors' Company, drawn up by me with a view to the re-arrangement of the school and its studies, when it shall be removed to the Charterhouse, the importance of scientific instruction is not overlooked. I cannot, of course, pledge the Company or the new Head Master to the adoption of that scheme, but I have little doubt that the educational basis of the school will be enlarged, not merely in the way of scientific instruction, but in other ways.

I am, dear sir,
Yours faithfully,
J. A. HESSEY, D.C.L.,
Late Head Master of Merchant
Taylors' School.

To the Secretary of the Commission
on Scientific Instruction.

---

15. ETON COLLEGE.

Eton College, Windsor,
SIR, Feby. 2, 1871.

I ENCLOSE some printed forms which show the arrangement of classes receiving scientific instruction at Eton, and I beg to add the following explanation.

The upper boys at Eton (*i.e.*, the sixth and fifth forms, containing together about 450 boys), are divided into three groups, A., B., and C. Group A. contains the first 100 boys in the school, divided into various classes for classics, mathematics, &c. Groups B. and C. comprise the rest of the fifth form, consisting of (about) 350 boys in all.

All boys in groups B and C have two lessons a week in some scientific subject, and have questions to answer or notes or short essays to write out of school.

An average boy gets into the fifth form (*i.e.*, the lower part of the C. division), at from 14 to 15. It takes him two years and a half or three years to pass through the C. and B. divisions into the first 100. During this time he is *obliged* to learn some branch of science. When he reaches the first 100 (*i.e.*, the A. division), he has a choice of subjects, some branch of science being amongst them. Boys begin generally with physical geography, and afterwards have mechanics, hydrostatics, and astronomy, but we have to alter the order of subjects, occasionally, to adjust the classes. This system has been going on for nearly three years, and is, I think, working fairly well.

In October last we got our new laboratory opened, and Mr. Madan, the Lecturer in Chemistry, besides teaching a voluntary class of the A. boys, has a class of about 35 (not volunteers) in chemistry from the B. division, and the same number in physics (heat) from the C. division. He is also about to start a voluntary class in chemistry for younger boys. Some of the upper boys come voluntarily for extra work to the laboratory in playhours. The chemistry classes have, I think, been very successful indeed.

Boys in the ordinary course are compelled to begin chemistry before they get through the B. division. The best of these generally volunteer to go on with it afterwards. The success of the chemistry teaching makes me wish very much to have another science teacher, *e.g.*, for botany and geology. I believe we should get very good results from it.

I am, sir, your obedient servant,
J. J. HORNBY.

The large table headed A. division, Lent School Time, 1871, shows the arrangement of the voluntary classes in the first 100. Every boy must take up *two* subjects, *e.g.*, French and German, or French and Chemistry, or one of the extra classical books there mentioned, or Italian, or Modern History, but he selects for himself which two subjects he shall take.

The other classes given in tables B. and C. are in no sense voluntary. The subjects and hours are prescribed.

I send a few specimen papers of questions, such as are given weekly, or set in the examination at the end of the school time.

A. DIVISION.—LENT SCHOOL-TIME, 1871.

PLATO. Mr. Johnson.	FRENCH.		GERMAN.		ITALIAN.	ÆSCHYL. AGAM. Head Master.	CHEMISTRY.	MOD. HISTORY. Mr. Browning.
Thursday and Saturday, 9.45.	Tuesday, 9.45; Friday, 3.	Thursday and Saturday, 9.45.	Tuesday, 9.45; Friday, 3.	Monday and Wednesday, 9.45.	A. Thursday and Saturday, 9.45.	Tuesday, 9.45; Friday, 3.	A. Monday and Wednesday, 10.30.	Tuesday, 9.45; Friday, 3.
	Mr. F. Tarver.	Mr. H. Tarver.						
Radcliffe *ma.* K. S.	Carter, K.S.	Tilley, K. S.	Formby	Pulman, K. S.	Stapylton	Radcliffe *ma.* K. S.	Blakesley, K. S.	Gould, K. S.
Macaulay *max.* K. S.	Neal	Benson	Farquhar	Carter, K. S.	Preston	Tilley, K. S.	Mulholland *ma.*	Chute *ma.* K. S.
Wintle	Courthope *ma.*	Farquhar	Smith	Douton, K. S.	Prideaux-Brune	Salt, K. S.	Sayer, K. S.	Stapylton
Balfour	Longman	Harcourt	Bovill	Donkin *ma.* K. S.	B.-Reynardson *ma.*	Pulman, K. S.	Reade, K. S.	Paul, K. S.
Lacaita	Hayes	Mr. Sidney	MacCall	Pryor *ma.*	Leahy	Douton, K. S.	Hall	Dawson
Hobhouse	Edmonstone	Hollway, K. S.	Hanbury *ma.*	Hall	Reade, K. S.	Macaulay *max.* K. S.	Ritchie, K. S.	B.-Reynardson *ma.*
Paul, K. S.	Day		Birkbeck	Murray *ma.*	Macnaghten	Wintle	Neal	Thurston *ma.* K. S.
Joynes, K. S.	Bonsor *ma.*		Ruggles-Brise *ma.*	Courthope *ma.*	Cartwright	Tabor	Cooke, K. S.	Milman, K. S.
Radcliffe *mi.* K. S.	Ridley *ma.*		Grainger, K. S.	Collin, K. S.		Balfour	Spring-Rice, K. S.	Durnford *ma.*
Donkin *ma.* K. S.	Middleton *ma.*			Lees		Benson	Hayes	Ryder
Heathcote				Browning, K. S.		Lacaita	Greenwood *ma.*	Grubbe *ma.*
Dawson				Harter		Joynes, K. S.		Cammell *ma.*
Armitstead *mi.* K. S.				Bonsor *ma.*		Radcliffe *mi.* K. S.		Cole
Corrie, K. S.				Bode, K. S.		Blakesley, K. S.		Donaldson *ma.*
Thurston *ma.* K. S.						Keating, K. S.		
Selwyn, K. S.						Heathcote		
	Mr. Roublot.	Mr. F. Tarver.	Thursday and Saturday, 9.45.	Monday and Wednesday, 10.30.	B. Thursday and Saturday, 10.30.		B. Thursday and Saturday, 10.30.	
Welldon, K. S.	Prideaux-Brune	Formby	Donaldson *ma.*	Arkwright	Salt, K. S.	Mulholland *ma.*	Hobhouse	
Tarver, K. S.	Leahy	Pryor *ma.*	Swan, K. S.	Harcourt	Gould, K. S.	Armitstead *mi.* K. S.	Keating, K. S.	
Milman, K. S.	Brown	Ricardo	Middleton *ma.*	Mundy, K. S.	Chute *ma.* K. S.	Corrie, K. S.	Smith	
Bryans, K. S.	Greenwood *ma.*	Acland-Hood		Mr. Sidney	Tabor	Selwyn, K. S.	Ryder	
Ritchie, K. S.	Harter	Arkwright		Wilkinson	Ricardo	Welldon, K. S.	Edmonstone	
Cooke, K. S.	Buxton	Bovill		Anson	Brown	Tarver, K. S.	Day	
Mundy, K. S.	Johnson	MacCall		Buxton	Longman	Sayer, K. S.	Lawford *max.*	
Collin, K. S.	Myers *ma.*	Durnford *ma.*		Johnson	Spring-Rice, K. S.	Acland-Hood	Cammell *ma.*	
Browning, K. S.		Anson			Lees	Bryans, K. S.	Bode, K. S.	
Grainger, K. S.		Grubbe *ma.*			Downes, K. S.	Macnaghten	Ridley *ma.*	
		Hanbury *ma.*			Mr. Bruce	Murray *ma.*	Heygate	
		Birkbeck				Downes, K. S.	Myers *ma.*	
		Ruggles-Brise *ma.*				Cartwright	Cole	
						Lawford *max.*		
						Heygate		
						Mr. Bruce		
						Hollway, K. S.		
						Swan, K. S.		

Lent School-time, 1871.

Physical Science.

B.

Monday, 7.30 a.m. Friday, 5.15 p.m.

Chemistry.

DIV. IV. - - - - - Mr. Madan.
(In the Laboratory.)

Physical Geography.

DIV. V.—Farrer to Kirklinton-Saul - Mr. Hale.
(In Mr. Wolley-Dod's Schoolroom.)
DIVS. V. & VI.—Caldecott to Daniel - Mr. Mozley.
(In Mr. Mozley's Schoolroom.)
DIV. VIII. - - - - Mr. Cockshott.
(In Mr. C. C. James' Schoolroom.)

Astronomy.

DIV. VI.—Oliphant to Sturgis - - Mr. Carter.
(In Mr. Carter's Schoolroom.)
DIVS. VI. & VII.—Heywood-Jones to Thring - - Mr. Dalton.
(In Mr. Joynes' Schoolroom.)

Mechanics.

DIV. VII.—Tennyson to Miles *ma.* - Mr. Rouse.
(In Mr. Rouse's Schoolroom.)

C.

Wednesday, 3 p.m. Saturday, 9.45 a.m.

Heat.

DIV. IX. - - - - - Mr. Madan.
(In the Laboratory.)

Physical Geography.

DIV. X.—Tatham, K. S. to Fort - Mr. Mozley.
(In Mr. Mozley's Schoolroom.)
DIV. XI. - - - - Mr. Hale.
(In Mr. Snow's Schoolroom.)
DIV. X.—Fraser to Bowman }
DIV. XII.—Jervis to Thomas } - Mr. Cockshott.
(In Mr. Thackeray's Schoolroom.)

Mechanics.

DIVS. XII. & XIII.—Morris to Mr. Lawley - Mr. Rouse.
(In Mr. Rouse's Schoolroom.)

Astronomy.

DIV. XIII.—Marjoribanks *ma.* to La Terrière - - - Mr. Dalton.
(In Mr. Browning's Schoolroom.)
DIV. XIV. - - - - Mr. Carter.
(In Mr. C. C. James' Schoolroom.)

Div. I., II., III.—A.

Chemistry.

Midsummer 1870.

1. Describe the properties of the different allotropic forms of phosphorus, stating how the one may be converted into the other.
2. What compounds does phosphorus form with oxygen? Give the mode of preparation, and the properties of the highest oxide.
3. What is that property of acids which we call their "basicity"? Illustrate your answer from the acids of phosphorus.
4. Describe experiments which illustrate the affinity of chlorine for hydrogen, and give the chief properties of the substance formed by their union.
5. How is "bleaching powder" prepared, and for what purposes is it used? Give experiments.
6. Give the sources, the mode of preparation, and the tests for the presence of iodine.
7. Enumerate the chief properties of chlorine, bromine, and iodine, in such a way as to show that they form a group in which bromine occupies the middle place.
8. How should we decide whether a body should be called a metal or a non-metal? Take, as instances, antimony, graphite, lead, pyrites.
9. What is meant by the atomicity of a substance? How are metals classified according to their atomicity?
10. To what group of metals does silver belong? Mention its chief ores, and the method of obtaining the metal from them.
11. Give examples of the different methods by which silver may be reduced from its compounds.

Div. I., II., III.—B.

Chemistry.

Midsummer 1870.

1. Describe an experiment which shows how nitrogen may be made to combine directly with oxygen; state which oxide is formed, and by what test we may recognise its presence.
2. Give the method of preparation and properties of nitrogen dioxide.
3. Which of the nitrogen oxides combine chemically with water, and what subtances are thus produced?
4. State the four laws of chemical combination, illustrating them, as far as possible, from the series of nitrogen oxides.
5. Define an "atom" and a "molecule," and show on what principles the atomic weight of a substance may be determined although we cannot isolate and weigh a single atom.
6. How may it be shown that carbon exists in (*a*) chalk or marble, (*b*) sugar?
7. How is the presence of carbon dioxide in air accounted for, and why does it not accumulate there?
8. Contrast the properties of the two carbon oxides, and show how the one may be obtained from the other.
9. What different actions has chlorine upon ethylene? Express the changes in the form of equations.
10. Describe briefly the process for manufacturing coal gas.
11. What is combustion? Describe experiments which illustrate its nature.
12. From what sources are boron and silicon respectively obtained.
13. How is boron trioxide obtained, and what are its properties?

Div. IV.

Chemistry.

December 1870.

1. Define "an element," "a compound." By what experiments may we prove that three of the four ancient elements are compound bodies?
2. Describe the construction of an air pump; and give any two experiments which prove that air has weight.
3. The readings of a barometer on two successive days were 30·258 in. and 29·432 in. Show clearly what is meant by this statement, and reduce the readings to millimetres.

(The metre = 39·37 in.)

4. What is the law which expresses the change in volume of a gas when the presure upon it is varied? Describe an apparatus which illustrates this law.
5. Give examples of chemical combination at ordinary temperatures between (*a*) two solids, (*b*) two gases.
6. From what sources may oxygen be obtained? Describe the ordinary method of preparing the gas, giving a sketch of the apparatus used.
7. When is a substance said to have a "neutral," "acid," and "alkaline" reaction respectively? Give examples.
8. Enumerate the chief properties of hydrogen, describing experiments by which they may be demonstrated.
9. A rectangular india-rubber bag 1 metre long, 50 cm. broad, and 30 cm. deep, is to be filled with hydrogen. How much zinc is required for the purpose.

(One gramme of hydrogen is obtained for every 32·5 grammes of zinc dissolved. One litre of hydrogen weighs 0·0896 grm.)

10. What other substances besides oxygen and nitrogen occur in air, and how may their presence be detected and accounted for?
11. Describe fully an apparatus for the analysis of air by leading it over heated copper.

By means of such an apparatus Dumas found that 100 grms. of pure dry air consisted of 23 grms. of oxygen and 77 grms. of nitrogen.

The weight of 1 litre of oxygen is 1·430 grm.; of nitrogen 1·256 grm.; of air 1·293 grm. Calculate from these data the composition of 100 litres of air by volume.

12. How may ammonia be prepared and collected? Give the chief properties of the gas.

Astronomy.—B.

November 21st, 1870.

1. Explain (with a figure) how a solar eclipse is caused, and mention some of the phenomena which accompany it.
2. What is meant by "spring tides" and "neap tides?" Show what causes combine to produce them.

3. Write a short general account of the solar system.

4. State what you know of the planets Venus, Mars, and Jupiter, as to magnitude, distance from the sun, and attendant satellites.

5. When and by whom was the velocity of light discovered? What observations led to its discovery? Write a short account of a terrestrial experiment bearing on this subject.

6. What are the "signs of the Zodiac?" From what do they take their names? Into how many constellations are the heavens divided? By whom was the arrangement made? Why does the discovery of new stars not involve new constellations?

7. What is the present rule for the determination of a leap-year? Give a full account of the changes made in the calendar during the Christian era.

8. How many kinds of years are recognised in astronomy? Explain why none of them can be used as our civil year, and state from which of them the civil year is derived.

Physical Geography.

1. Give, in round numbers, the distance of the earth from the sun, and the diameter of the earth.

2. What is the shape of the earth, and how is it caused.

3. What is the density of the earth as compared with water?

4. What is known of the heat of the interior of the earth?

5. Describe the atmosphere,—its composition, pressure, and extent.

6. Why is it incorrect to speak of parallels of longitude?

7. How are the rocks composing the earth's crust arranged by geologists?

8. Explain the following terms:—Metamorphic, oolitic, carboniferous, cretaceous, fossil.

9. What are the principal causes of the diversities of the earth's surface?

10. What districts of Europe have extensive continuous granitic formations?

11. What parts of Europe disclose strata of the secondary period?

Physical Geography.

B.—December 1869.

1. What are the chemical constituents of water?

2. What seas are exceptions to the rule that inland seas are less salt than the ocean, and why?

3. What is the mean depth of the ocean, and the mean temperature at great depths?

4. What is shown by the colour of a sea being green?

5. What are the principal causes which account for the existence of currents?

6. How do you account for currents, moving towards the equator, having a westerly course?

7. Give some account of the Gulf Stream.

8. What is the Sargasso Sea? and by what name do the French geographers call it?

9. What is the difference between wind-waves and earthquake waves?

10. What are Artesian wells? What proof have they afforded of the temperature of the interior of the earth?

11. Explain the terms—
Water-sched,
River-basin.

12. Enumerate the rivers forming the river system of the Arctic ocean. Give some account of three of them.

Physical Geography.

C.—May 1870.

1. What proportion of the earth's surface is covered by the ocean, and what are the chief basins into which it is divided?

2. What do you know of the Atlantic Ocean—its size, depth, bed, &c.?

3. Give some particulars concerning the Pacific Ocean.

4. What is known respecting the depth of the sea?

5. To what causes are the different colours of the sea to be ascribed?

6. What is known of the temperature of the sea?

7. What is the mean proportion of saline matter in the sea? How does the saltness of a sea affect its gravity? and what results from this? In what way does the water of the Mediterranean and Red Sea differ from sea water in general, and how do you account for this difference?

8. What has been observed respecting the magnitude and velocity of waves?

Give some illustrations of the form of waves. What is the difference between wind waves and earthquake waves?

Show how the wind waves are formed.

Physical Geography.

C.—Michaelmas School-time, 1870.

1. State what you know of the earth as a member of the solar system.

2. Describe fully the motions of the earth, and of any of the other planets.

3. What is a satellite? State fully what is meant by the word "month."

4. What result has the earth's rotation had upon its form? Do you know anything similar of other planets?

5. What is the cause of the seasons? How do we know the earth is round?

6. Explain the following terms: Ecliptic, tropic, equator, meridian. Why is there perpetual day or perpetual night at the poles?

7. Why is it incorrect to speak of parallels of longitude?

8. What is the composition of the atmosphere? How and why does pressure vary?

9. What is known of the interior of the heat of the earth?

Physical Geography.

C.—November 1870.

1. What are the two main classes into which the materials of the earth's crust are divided? What class is there intermediate between these, and what are its characteristics?

2. Give the principal kinds of stratified rock in each of the three geological periods.

3. What are fossils, and how do they serve to establish the age of different strata?

4. Give the chief fossils belonging to the different periods. What kinds are most abundant through all of them?

5. What is the nature of basalt? and where in the British Islands is it found?

6. State the geological character of the country near Eton.

7. Describe geologically any three counties in different parts of England.

8. Give the meaning of the terms Eocene, Miocene, Pliocene. In what part of England do we find the rocks of oldest formation?

Physical Geography.

C.—December 7th.

1. Show how rain exercises a destructive effect on the surface of the earth. Give instances.

2. Give as many instances as you can of the destructive effects of rivers.

3. Explain why waterfalls often occur in rivers.

4. What is meant by denudation? How is this exemplified by deltas? Draw a map of the deltas of either the Nile or the Mississippi.

5. What is an avalanche, and how is it caused?

6. Explain the effect of frost on a chalk cliff.

7. How are glaciers formed? What effects are caused by glaciers?

8. How do you account for the parallel roads of Glen Roy?

9. What are erratics?

10. Give some account of the different effects caused by the action of the sea.

Class Examination Paper set in the course of the School Time.

Hydrostatics. B. Division.

1. Distinguish between the three different states of matter.

2. Describe the Florentine experiment, which was supposed to prove that liquids are incompressible. What did it really prove?

3. Define the words "horizontal" and "vertical."

4. What is meant by saying that "water rises to its own level?" How much allowance has to be made in levelling for the curvature of the earth's surface?

5. What makes water rise to the surface in Artesian wells?

6. How did Pascal prove the immense pressure of a long thin vertical column of water?

7. How is it proved that the pressure on the base of any vessel containing liquid depends not upon the weight, but upon the height of the liquid?

8. Describe a safety valve.

9. When a body is placed in water, by how much is its apparent weight less than its real weight? How was this fact discovered?

Class Examination Paper set in the course of the School Time.

Machinery. C.

1. Show how a moveable pulley doubles the force of a workman.
2. Give figures of moveable pulleys, hanging by the same, and by different, strings. Show what forces balance each other on each of them.
3. Mention different kinds of levers, and state where the force is applied, and where the resistance is overcome in each.
4. At what distances from the fixed point will weights of 10 lbs. and 2 lbs. balance each other on a straight lever?
5. Draw figures of a wheel and axle, showing clearly how the ropes work, and the advantage of using the machine.
6. What substitutes are used in a windlass and a capstan for a wheel and rope?
7. What substitutes are used in a rack and pinion for an axle and rope?
8. Show how a crane works, and how it multiplies force.
9. When force is multiplied by any machine, show that longer time is spent.

Collections—July 1869.

C. Division.

1. The arms of a balance are of unequal lengths. What weights in the scale-pans will keep the beam horizontal?
2. Describe any common machine for weighing light articles, *e.g.*, letters.
3. Give examples of different kinds of levers, showing in each case where the fulcrum is, and where the power is applied. To which kind does a wheelbarrow belong, an oar, a man's arm, a pair of shears.
4. Describe a machine for weighing heavy carriages. Explain carefully how the different levers composing it are supported, and at what point each is pressed down by the carriage.
5. The shafts of a cart are inclined upwards. What portion of the force exerted by the horse is effective in pulling the cart? What becomes of the rest of the force?
6. Two toothed wheels work together: the first is turned by a handle, the second turns an axle on which a rope is coiled. Compare the weight lifted with the force used.
7. What objections against the common screw are overcome by Hunter's screw? Explain how it is that, in this machine, the plate does not descend as rapidly as the upper screw. Compare the pressure with the force used.

Collections—Easter 1870.

Hydrostatics. B.

1. Mention some illustrations of the principle that the free surface of a liquid is a horizontal plane.
2. Describe Bramah's press and the contrivance for making it water-tight. Account for the pressure produced by it.
3. Give figures of a common pump, and of an air-pump.
4. Show how to find the specific gravity—
   1. Of a solid; 2. Of a liquid.
5. Explain how it is that water can be lifted in a thin straight open tube.
6. Describe Boyle's experiments with compressed air. What conclusions did he draw from them?
   How far has a diving bell descended when the air is compressed into half its original volume?
7. Account for the action of a siphon, and of an intermittent spring.
8. Describe the hydraulic ram.
9. What keeps the mercury in a barometer from sinking down into the cistern? If a small hole were bored in the middle of the tube, what would happen?
   How can a barometer give an indication of the probable state of the weather.
10. Describe a single-action steam engine. Explain what forces cause the alternate motion of the beam.
    What is the object—
    1. Of the fly-wheel; 2. Of the governor?
11. What is the use of the small hole in the lid of a tea-pot?

Collections—July 1870.

Astronomy. B.

1. Distinguish between nebulæ and star-clusters; stating what is the present state of our knowledge as to each?
2. Show how the Milky Way helps us to determine approximately the shape of the universe. Referred to the Milky Way, what is the position of the sun?
3. How are the stars in each constellation known and arranged? Name 10 of the brightest stars in the heavens.
4. State what is known of the physical constitution of the stars. What is the photosphere of a star, and what the atmosphere? What are the materials of photospheres, and in what state do they exist?
5. How, in a general way, would you describe the surface of the sun?
6. Explain fully the cause to which we owe the succession of day and night.
7. What are the latitude and longitude of a place?
   How much does the polar diameter of the earth differ from an equatorial diameter? Are all equatorial diameters the same?
8. Explain the cause of a solar eclipse. In the late lunar eclipse, why did the moon appear copper-coloured during the totality?
9. To what is the phenomenon of a shower of meteors due? Why do meteors occasionally reach the surface of the earth, and what are they then called?
10. State the facts of any well-authenticated cases of aërolitic falls which you remember.
11. Explain the action of a convex lens upon a beam of parallel rays of light, and show with a figure how lenses are made use of in an astronomical telescope.

Collections—Election, 1870.

Physical Geography. C.

July 20th.

1. What is meant by (i.) watersched, (ii.) river basin?
2. Which is the right and which the left bank of a river?
3. On what does the velocity of a river depend, and what geological effect does a rapid current produce?
4. Name the Oceanic river systems?
5. Name the principal Siberian rivers. What are their characteristics?
6. Which are the chief European rivers flowing directly into the Atlantic? Describe one of them.
7. What renders the European rivers so important, both geographically and politically?
8. What are the chief rivers flowing into the Mediterranean?
9. Give some account of the Nile, and of its annual inundations.
   What historical evidence do the inundations afford?
10. What has been ascertained of late years respecting the source of the Nile?
11. What is known of Central Africa?
12. What are deltas, and how are they formed?

Collections—December 1870.

Astronomy. B.

1. Enumerate the various classes of the heavenly bodies, stating briefly the characteristics of each.
2. Give reasons for believing that the earth turns round an axis.
3. What are the trade winds? Explain how each of the two parts of their direction is caused.
4. Explain the action of the tides, showing why, when there is high tide at any place, there is so also at the antipodes of the place.
5. What are the causes which produce twilight?
6. How many kinds of days are recognised in astronomy? Why does the time by a sun-dial generally differ from that by a clock? What is the *maximum* difference?
7. Write out Kepler's laws, and explain the second of them with a figure. Taking the earth's distance from the sun as 91,000,000 miles, and the distance of Mars from the sun as 140,000,000, find approximately the length of the year in Mars.
8. Give a short account of the constitution of a comet, and state what you know of the comet of 1843.
9. On what occasion can the distance of the sun be best determined? When will the next opportunities occur? Show briefly, with a figure, how the observations are conducted.

Fifth Form Trials—November 17, 1870.

Thursday, 10.30—12.

PHYSICAL SCIENCE.

Astronomy.

1. Enumerate the various classes of heavenly bodies, stating briefly the characteristics of each.

2. Explain (with a figure) how a lunar eclipse is caused, and account for the moon during a total eclipse sometimes being copper-coloured, and at others being dark.

3. When, and by whom, was the finite velocity of light discovered? What observations led to the discovery? Write a short account of an experiment which corroborates it.

4. Explain fully the two principal causes of the change of seasons.

5. Explain and account for the phases of the moon, with a figure. What other bodies exhibit the same phase.

6. What do you know concerning the dimensions and nature of the sun?

7. Explain "ecliptic," "signs of the zodiac," "zenith," "declination."

8. To what constellations do the following stars belong: —Sirius—Aldebaran—Capella—Vega—Rigel—Alcor?

Machinery.

1. Give a figure of a system of pulleys, each hanging by a separate string, and show what forces will balance each other on it.

2. In the various modifications of the wheel and axle—what substitutes are used for the wheel, and what for the axle? Give figures of one of each, with forces that balance each other.

3. What is meant by the statement that water rises to its own level.

Explain the Artesian well, and describe a system upon which the supply of water to a town is usually conducted.

4. To what height will water rise when the air upon it is exhausted, and why? How is the air exhausted, and the water lifted out of a common pump?

16. MARLBOROUGH COLLEGE.

Marlborough College,
July 27, 1870.

SIR,

IN acknowledging your letter to the Master, I have to inform you that he is at present travelling on the Continent, and that I have no directions to forward any letters; but on his return in September your letter will receive his attention.

I am, sir,
Your most obedient servant,
J. Norman Lockyer, Esq. JAMES LEADER.

Cranbrook, Kent,
Jan. 21, 1871.

DEAR SIR,

YOUR note reached me this morning. As I have not yet entered on my duties at Marlborough College, I am unable to furnish, at present, any accurate reply to your inquiry.

If you will apply to the Master of University College, Oxford, he will be better able than myself to tell you about the scientific work of the College during the past years, and at some *later* period I shall be able to tell you more myself.

I may add that it is my own earnest desire, as soon as I am settled in the Mastership, to do all I can to develope and promote the scientific instruction now given.

I am your obedient servant,
D. Wooster, Esq., FREDERIC W. FARRAR.
Assistant Secretary.

University College, Oxford,
Feb. 2, 1871.

SIR,

I AM sorry that I omitted to collect the materials for the Commission.

I must confess to having done so. The pressure of work on a Head Master is very great, and the frequent applications for an account of one's work interfere very seriously with doing the work.

As it is I must, I fear, refer you to my successor, who will return to Marlborough about the 9th inst., when the school reassembles. As it has not been my habit to keep careful statistics of every item of work done in the College, and as some of the questions, as to the results of work, were not, if I remember, of a nature to be very easily answered, the answers which you will receive will be somewhat vague, but a general idea of the work done can easily be given.

Your obedient servant,
G. G. BRADLEY,
Late Master of Marlborough College.
D. Wooster, Esq.

17. KING'S COLLEGE SCHOOL.

King's College School, London,
Feb. 7, 1871.

MY LORDS AND GENTLEMEN,

I REGRET extremely that your questions have remained so long unanswered. They reached me just when our Midsummer Term was concluded, and during our Winter Session our arrangements for scientific instruction were disarranged, owing to the resignation of our lecturer, and the necessity for the appointment of his successor.

I can now, however, give you some statistics as to our present position.

1. King's College School is divided into three departments—

a. The classical school, numbering about 108 boys.
b. The modern school, numbering about 195 boys.
c. The lower or preparatory school, numbering 143 boys.

2. The instruction in science is given partly in the school, and partly in the lecture rooms of the College.

3. These lectures embrace—

1. Theoretical chemistry.
2. Practical chemistry.
3. Natural philosophy, including the subjects required at the London University Matriculation Examination.

4. (1.) The number of boys attending the higher lectures on theoretical chemistry - 63
(2.) The number attending the higher natural philosophy lectures - - - 43
(3.) The number attending the practical chemistry class, and working in the laboratory - - - - 17
(4.) Number attending a still higher chemistry class - - - - - 1
(5.) Number attending the junior class in natural philosophy is
A. (or classical school) - - - 56
B. (or modern school) - - - 101
C. (or lower school) - - - 33

All the boys in the modern school receive scientific instruction, and plans are in formation for developing the system still further.

There is also a class for practical instruction in the workshops, in iron work, metal work, &c., numbering from 25 to 30, though sometimes a smaller proportion.

I am
Yours very faithfully,
G. F. MACLEAR, B.D.,
Head Master.

18. DULWICH COLLEGE.

Dulwich College, Feb. 8, 1871.

SIR,

IN reply to the inpuiry made by you on behalf of His Grace the Duke of Devonshire and the Royal Commissioners on Scientific Instruction, I beg to make the following statement:—

In endeavouring to give an accurate account of the position assigned to scientific teaching in Dulwich College, I am met at the outset by a difficulty which will be at once recognized by the Commissioners, namely, that while our scheme of instruction on science is unusually comprehensive, it is only during the last six months that the completion of the new buildings has rendered it possible to bring it into efficient operation, and that I am at the present time actively engaged (with the sanction of the Governors of the College) in organising science classes and lectures.

With regard to the systematic teaching of science, there has been constructed, in connexion with the new buildings, a large and commodious laboratory with all the most recent and approved appliances for chemical manipulation. There are, at present, tables or compartments for 20 pupils, each with separate drainage and services of gas and water; and provision has been made for the addition of 18 more such tables. A lecture theatre, fitted with desks for taking notes, and capable of accommodating 220 or 230 students, and with rooms adjoining for the necessary apparatus and stores, has also been erected.

Instruction in science is now given as follows:

Chemistry.—A class for instruction in chemistry was definitely formed in September 1870, and placed under the charge of Dr. Debus. F.R.S. (Lecturer in Chemistry at Guy's Hospital), to whom I am greatly indebted for his valuable aid in organising this department. The class numbered during the last term 36 boys.

In the present term, the students have been divided into two classes of 20 boys each, which receive instruction separately.

The time devoted to the subject has been about 3½ hours per week, exclusively of "preparation." This time has been thus apportioned :

On Wednesday morning a lecture with illustrative experiments in the theatre - -	1 hour
On Wednesday afternoon, laboratory work under the direction of the chemical instructor or his assistant - - - - (Extended in some cases to 2 hours)	1½ hours
On Saturday morning a class lesson, including the correction of the student's notes on the previous lectures - - -	1 hour

An examination is held at the end of each term, and prizes are assigned for each class at the annual examination of the school.

Instruction in chemistry is not compulsory, and is limited to the "senior school;" that is, to boys in all cases above 13, and, with few exceptions, above 14 years of age.

No additional charge is made for instruction in this department. The only expense incurred by the students is the cost of class-books and of such pieces of apparatus (glass tubing, funnels, &c.) as are most conveniently treated as articles of personal property.

Similar arrangements will be made for giving instruction in other branches of physical science as soon as it is found practicable and expedient to introduce them.

In no case will any additional fee for instruction be charged.

No other subject strictly belonging to the class of physical sciences has at present been included in the course of direct and systematic instruction, except—

Physical Geography.—For this subject also a class was formed in September last. There are now 60 boys under instruction, who are divided into two classes, the higher of which receives each week two lessons, and the lower one lesson, alternated with a lesson on political and historical geography.

One or two other branches of science have, however, been incidentally taught in connexion with other departments of instruction, especially—

Comparative Anatomy, in which instruction has been given during the last three years to a few of the more advanced pupils in the drawing department, including some who were preparing to enter the medical schools of the London hospitals; and—

Colour, which has also been treated scientifically in all cases in which it has formed a part of the art instruction.

In these subjects, however, not more than five or six boys, whose intended pursuits in life required special training, have received instruction in any one year.

It is scarcely necessary for me to add that in the mathematical department, instruction has been given in geometry and mechanics, though with reference chiefly to the mathematical course at the universities.

Another and (as I believe) a very important provision in the scheme of science teaching, consists in the courses of *evening lectures* on various scientific subjects, in the lecture theatre.

All boys in the "senior school" are encouraged to attend these lectures, which are open also (upon the recommendation of their form masters) to any boys of the junior school who may be desirous of availing themselves of them. The lectures are designed, not so much to impart exact knowledge (for this we look rather to our science classes), as to stimulate an interest in scientific subjects, and to convey such general information as may be fairly considered essential to a liberal education.

Arrangements have already been made for a course of evening lectures (one in each week), during the present term, on Light and Heat. A similar course will be delivered after Easter on Geology.

It is intended to provide, as speedily as possible, complete sets of apparatus, of the best quality and construction, for experiment and illustration in the several departments of scientific instruction. Some progress has already been made in this direction.

It would obviously be premature to speak of the *results* of arrangements of so recent date, and as yet to so great an extent of a tentative character. On one point, however, I feel justified in speaking with confidence. I am convinced that the introduction into our great schools of a wider range of optional studies is productive of incalculable advantage, not to the few alone (as is sometimes supposed), but to the many also. It gives the opportunity of searching out and developing tastes and talents, where the very existence of any taste or any talent at all was before scarcely suspected.

And this is, I am sure, especially the case with the teaching of physical science, which, whatever be its value (and I believe it to be great), as an instrument of general mental training, is unquestionably the means, in many cases, of stimulating apparently dormant intellects into a healthy and vigorous activity, which reaches far beyond the subjects which originally called it into exercise.

And though it is probable that the highest places in our science classes will generally be won by boys who are at least amongst the more intelligent and earnest students in the ordinary work of the school, still much will be gained by the whole community, morally as well as intellectually, if only a few more of its members are withdrawn from the class—never, I fear, to be wholly eradicated—of the aimless and apathetic, and supplied with an object and an occupation.

In making these few remarks I have thought it right to restrict myself to the question of the practical utility of the subjects as a means of school training, without expressing any opinion as to their relative importance, as compared with other branches of instruction.

I am, &c.,
ALFRED J. CARVER, D.D.,
Master of Dulwich College.

---

19. ST. PAUL'S SCHOOL, LONDON.

St. Paul's, E.C.,
SIR, Jan. 30, 1871.

I AM sorry to have acted with such seeming discourtesy, but as I had no return to make, as regards what is generally understood by the term "scientific education," for St. Paul's School, and your communication of last July seemed only a circular, I did not at the time, which was in the holidays, see the necessity, of which I am now reminded, of making a reply.

We encourage such studies in all sorts of ways, short of introducing them formally into our school curriculum; but many of our scholars attend physical science lectures at the London Institution, and some have highly so distinguished themselves in the Universities of Oxford and Cambridge.

We have, in fact, no time, nor indeed space, to extend our system at present, the boys not residing here, and the school accommodation being too much stinted to allow additional class rooms for practical instruction.

I am, Sir,
Yours faithfully,
H. KYNASTON, D.D.,
High Master.

---

20. GRESHAM COLLEGE.

Gresham College, E.C.,
SIR, Jan. 31, 1871.

YOUR letter addressed to the Principal of Gresham College has been handed to me.

You are, perhaps, unaware that Gresham College is a place for lecturing to the public, and not for teaching boys or classes.

I beg to refer you to the Charity Commissioners, who made long inquiries into our work, and into the trusts under which we hold our offices.

Scientific *instruction* it cannot properly be called, but scientific lectures of a popular kind are delivered to the public at large, under the will of the founder, and as the lectures are addressed to the public, there is no means of answering your inquiry.

Generally, I may say that the attendance at the scientific lectures is fair, and that many persons seem to enjoy the advantage of hearing popular expositions of scientific subjects.

The more popular the lecture the better it is attended, but the departure from the intentions of the founder is more glaring.

No evidence from the attendance at our lectures is of much use for the purposes of your Commission in my opinion.

Your obedient servant,
B. M. COWIE,
Gresham Lecturer on Geometry.

I daresay some of our lecturers would be glad to be called before you for your examination.

---

21. HARROW SCHOOL.

DEAR SIR, Harrow, July 25, 1870.

I HAVE handed your note to my colleague, Mr. Griffith, our Master in Natural Science, and I have requested him to have the kindness to answer the various questions addressed to me by your Commission.

I am, dear sir, faithfully yours,
H. MONTAGU BUTLER.

SIR, Harrow, March 7, 1871.

I HAVE been requested by Dr. Butler to give you information with reference to the instruction in natural science given in Harrow School. I enclose a statement. Should the Commissioners require further details, I will gladly furnish them.

Your obedient servant,
GEORGE GRIFFITH.

A system was established several years ago at Harrow for the encouragement of the study of natural science by means of voluntary examinations. An account of this is given in Appendix C. of a Report "On the best means for promoting scientific education in Schools," published in the Report of the British Association for the Advancement of Science for 1867, p. liii. This system is, with some modifications, still maintained.

Four years ago a master was appointed for the purpose of giving systematic instruction in natural science, and the subject was made part of the ordinary school work in a certain number of forms, which at that time included nearly 200 out of the 500 boys in Harrow School. At present all boys in the 5th form on the classical side, and the whole of the modern side, receive instruction in experimental physics.

Those who are on the classical side attend one lecture a week. In number they are about 140, and they are arranged in four divisions, the order of which depends on proficiency in classics, mathematics, natural science, and modern languages.

The modern side, consisting at present of about 40 boys was established in 1869. They are taught in two divisions the places in which are determined by proficiency in mathematics. Each division attends three lessons a week.

Boys in the 6th form, and in forms below the 5th on the classical side, are not taught natural science in school. Those, however, who desire to receive instruction in those subjects which the natural science master undertakes to teach, are allowed to have private lessons during the hours which are not allotted to school work. A few only receive instruction under these conditions.

B. REPLIES to SECRETARY'S LETTER, dated Sept. 27, 1872.

On the 27th of September 1872, the letter and schedule given below were sent to the Head-Masters of the following Colleges and Schools:—

Charterhouse School.
Cheltenham College.
Christ's Hospital.
City of London School.
Clifton College.
Derby Grammar School.
Dulwich College.
Eton College.
Harrow School.
King's College School.
Manchester Grammar School.
Marlborough College.
Merchant Taylors' School.
Rossall School.
Rugby School.
Saint Peter's College, Westminster.
Stonyhurst College.
Taunton College School.
University College School.
Wellington College.
Winchester College.

Aid to Science Commission,
6, Old Palace Yard, London, S.W.,
SIR, Sept. 27, 1872.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to state that the Commissioners are extremely anxious to obtain the fullest information respecting science teaching in the public and first-grade schools, and the Commissioners will, therefore, feel greatly obliged if, in addition to the information which you have already been good enough to furnish, you will kindly favour them by answering, as far as you may be able, the several questions in the accompanying schedule.

I am to add, that as the Commissioners are desirous of obtaining information from schools differing in organization, the questions in the accompanying schedule are designed to cover the work of a good many schools. It is not, therefore, expected that answers will be given to any questions but those which may happen to apply to your school.

I am further to say that I have been requested by His Grace to confer with you personally, to explain the precise objects the Commissioners have in view, and the kind of information which will be most valuable to them, if you consider such a course desirable, in which case I shall be obliged if you will inform me on what day it will be most convenient to you that I should visit your school.

I have the honour to be, Sir,
Your obedient servant,
J. NORMAN LOCKYER,
Secretary.

SCHEDULE of PARTICULARS on which Information is desired by the Royal Commission on Scientific Instruction and the Advancement of Science.

Name of School or College ______________________

General Arrangements.

I. How is the School classified?

II. Is Science a necessary part of the School course, or is it taught only in special forms or departments?

III. Copy of Time Table.

IV. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

V. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

VI. Amount of knowledge required before the study of Science is commenced.

VII. Is any alternative or choice of subjects offered? What departments of Science are preferred?
  (a.) By parents?
  (b.) By the boys?

VIII. What branch of Science receives most attention in the School, or is found by experience to have the greatest educational value?

IX. What weight is assigned to scientific attainments in determining a boy's position in the School?

Methods of Teaching.

X. What proportions of the lessons take the form respectively of—
  (a.) Oral teaching and demonstration?
  (b.) Book work?
  (c.) Practical work?

XI. Which form of lesson is found to be most effective?

XII. How are text-books used? *e.g.*, is book work supplementary or preparatory to the oral lesson?

XIII. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?

XIV. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

XV. Describe any method of teaching some special branch of Science which has been found successful in your School.

Instruments of Teaching.

XVI. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for Scientific Instruction, and how is it used?

(Plans and descriptions of these with statements of their cost and annual expense, should if possible, accompany this return.)

XVII. Number of assistants and curators, and annual cost.

XVIII. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

XIX. Is there a workshop? and if so, how, and for what particular purpose, is it used?

XX. What text-books are in use? distinguishing between those for the junior and senior classes.

XXI. To what books of reference, other than ordinary school books, have the scholars access?

XXII. Is there any Scientific Society or Club in connexion with the School? and if so, who compose it, how is it worked, and what is its influence on the boys?

Tests of Progress.

XXIII. How often is the work tested?

XXIV. In what way? *e.g.*, by examination of note books, or by oral or written questions?

XXV. By whom? by the teachers of the subjects, or by an independent examiner?

Teachers.

XXVI. Is there any difficulty in procuring competent Science Masters?

XXVII. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?

XXVIII. What evidence of scientific qualification tendered by candidates is found to be of most value?

XXIX. Can you state any results of Science teaching in the School? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the School.

XXX. Are any special rewards or encouragements (*e.g.*, exhibitions, scholarships, or prizes) open to successful students of Science in the School?

XXXI. What improvements, do you think, could be effected in the teaching of Science in your own School?

XXXII. What are the principal obstacles to the teaching of Science in your own School?

XXXIII. How could the Universities best assist Science-teaching in Schools?

XXXIV. Can you suggest any way in which Government could assist Science-teaching in Schools, as, for example, by inspection?

XXXV. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

____________________ Head Master.

Date ________________

The following replies were received:—

1. Merchant Taylors' School.

Merchant Taylors',
Sept. 30th, 1872.

Sir,

In reply to your letter of the 27th inst., I beg to inform you that hitherto no instruction in science has been given at this school, owing to the necessities of our situation.

I may inform you, however, that the members of the Court of the Merchant Taylors' Company, with a view to the greater advantages of this school, of which they are the governors, have recently purchased for it the site of the old Charterhouse School, now removed from London to Godalming.

Upon the removal of this school to its new site, it will doubtless undergo a complete re-organization, and the whole question of scientific instruction will receive the most careful consideration.

It would be premature, at present, to do more than add that the school governors have, at the present time, under their deliberations the important matters referred to in your letter.

I have the honor to be
Your faithful servant,
William Baker,
(Head Master).

2. St. Peter's College, Westminster.

General Arrangements.

Question 1. How is the school classified?—According to the attainments of the boys in classical and general learning. For mathematics in six divisions, according to proficiency in that study.

For French or German in groups of about 50 boys each, subdivided afresh into four or three classes according to proficiency.

For natural science the boys of the three highest divisions of the school, about 70 in number, and some 30 of the lower forms have been taken and classified afresh.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Necessary, under the new regulations, a copy of which is enclosed, for all boys old enough to profit by it and capable of following the teaching. There is a power of exemption in special cases vested in the head master, who must report all such exemptions annually to the governing body.

Question 3. Copy of time table?

Monday	8–9 (or 9–10)	10–12.30	3.30–5.30 (or 3–5).
Tuesday	8–9 (or 9–10)	10–12.30	3.30–5.30 (or 3–5).
Wednesday	8–9 (or 9–10)	10–12.30	
Thursday	8–9 (or 9–10)	10–12	3.30–5.30 (or 3–5).
Friday	8–9 (or 9–10)	10–12.30	3.30–5.30 (or 3–5).
Saturday	8–9 (or 9–10)	10–12.	

Monday, Tuesday, and Friday 5½ hrs.; Thursday 5 hrs.; Wednesday 3½ hrs.; Saturday 3 hrs.; 28 hours in all.

Preparation in the evenings and out of school.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately?)—

Classics, including English	15½
Theology	2½
History and geography	2
French or German	2
Mathematics	4
Nat. Science	2 (or 1 in junior class.)
	28

At least two hours a day of additional work in preparation is given by industrious boys, and one hour enforced from all.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?

62 Natural Science—Hydrostatics A.
27 Natural Science—Physical Geography B.
A. 3 classes—average age seniors 17.
juniors 16 or less.
B. 2 classes—average ages 16
15 or less.

Question 6. Amount of knowledge required before the study of science is commenced?

For upper division Euclid B. i. & ii.
Algebra to Quad. Equns.
and a fair knowledge of arithmetic.
For junior classes, Euclid B. i.
and arithmetic to decimals.

Question 7. Is any alternative or choice of subjects offered?—See answer 5.

What departments of science are preferred?

a. By parents?

b. By the boys?

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—"Applied physics" is the only branch which we have as yet attempted or have any space or appliances for. A course of lectures, &c. on *heat* seemed to answer best for the classes generally, but the subject of electricity was more interesting to a few of the best pupils.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—Not much.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—One hour per week. For another hour questions are answered under a master's eye.

(*b.*) Book work?—Text books are prepared by the boys out of school hours.

(*c.*) Practical work?

Question 11. Which form of lesson is found to be most effective?

Question 12. How are text books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Both.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—The boys prepare notes partly at, and still more after the lesson, which are examined by the teacher from time to time.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible accompany this return.)

One class room, with presses for apparatus, is used for science lectures, and other rooms are used for physical geography, mechanics, astronomy, &c.

Question 17. Number of assistants and curators, and annual cost.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—Willis's models of the mechanical powers. About 60*l.* worth of apparatus for illustrating lectures on heat and electricity. The master has brought and lent any diagrams which he needed.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—No.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

Gleig's series, Tate's Electricity.
„ „ Magnetism, &c.
And for a few more advanced pupils—
Balfour Stewart on Heat.
Ferguson — Electricity.
Ansted's and Hughes' Physical Geography.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—No.

Tests of Progress.

Question 23. How often is the work tested?—By weekly questions and half-yearly examinations.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—By written questions.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Chiefly by the teachers of the subjects.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.
(*b.*) Influence upon the general studies and intellectual life of the school.

Science teaching has not been given long enough, in any efficient form, at Westminster, to enable me to answer this question.

Question 30. Are any special rewards or encouragement (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—Prizes are given in books if deserved.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?

Question 32. What are the principal obstacles to the teaching of science in your own school?—Want of space and of time for the study. The school only possesses one large schoolroom and four class-rooms: and no further space can be obtained until certain life interests have expired. As to the question of time, reference to regulations ch. vii. sect. 1. (p. 23) will show what quantity of subjects is required to be taught to *all* boys.

Question 33. How could the Universities best assist science-teaching in schools?

Question 34. Can you suggest any way in which Government could assist science teaching in schools, as, for example, by inspection?

Question 35. Have you any other information to give, or suggestions to make, likely to be helpful to the Commissioners?—I can only repeat my conviction that if science teaching is to be really efficient as an instrument of education, it must be made the principal subject of study; and that schools should be divided into classes, some taking science, and others language, as the basis of their system, adding in each case such further studies as time will allow to be pursued with advantage. The notion of pressing all subjects on all schools is in my judgment fatal to any efficient training.

CHAS. B. SCOTT,
Head Master.

Oct. 4th, 1872.

3. MARLBOROUGH COLLEGE.

General Arrangements.

Question 1. How is the school classified?—There are three divisions of the school, the upper, the lower, and the modern school. The lower school contains all those junior boys whose attainments do not enable them to win a place in the upper school. The modern school is mainly composed of boys intended for the army and navy, for Woolwich, for the Engineering College, for the Indian Civil Service, and for business.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Two hours a week of science work forms a necessary part of the school work of the upper and two middle divisions of the modern school (about 80 boys); and one hour a week is necessary in the case of the upper shell, upper fourth A., and upper fourth B. (about 75 boys in all). Otherwise certain forms are grouped together for science purposes: thus about 10 boys from each of the three fifths (lower fifth A and B, and middle fifth), with five from the upper fith, and four from the sixth form for the upper voluntary science form of 43 boys. Again, about 10 boys from each of the upper shell, upper fourth A form and upper fourth B form, form the lower voluntary science form of 31 boys. Each of those forms are voluntary; there are three alternative subjects.

Question 3. Copy of time table?—The time table differs with each form, and is in some respects flexible, but an approximate analysis of the number of hours devoted in each form to each subject has been written out on the enclosed sheet.

Upper V.

Classics	13¾
Mathematics	4¼
Divinity	2
History and English*	2
French	2
Science	2
	26

Middle and Lower Fifths.

Classics	13½
Mathematics	4
Divinity	2
History	2
French	2
Verses or science	2
	25½

Upper Shell.

Classics	13½
Mathematics	4
Divinity	2
History	2
French	2
Science	2
	25½

Upper Fourths.

Classics	13½
Mathematics	4
Divinity	2
History	2
French	2
Science (compulsory)	1
Science or French or verses	1
	25½

---

* Sometimes three, one instead of a chemical lesson.
A classical and a French examination done out of school hours.

Middle and Lower Fourths.

Classics*	15½
Mathematics	4
Divinity	2
History	2
French	2
	25½

Modern School.

Upper Division.

Latin and English	4
French	4
German	4
Mathematics	6 or 8
Divinity	2
History	2
Science	2 or 4
Drawing	1

Middle Division (A).

English	1
French	6
German	5¼
Mathematics	6
Divinity	2
History	2
Science	2
Drawing	2
	26¼

Middle Division (B).

English	2
French	7¼
Latin	3
Mathematics	6¼
Divinity	2
History	2
Science	2
Drawing	1
	25½

Lower Division.

English	2
French	6
Latin	6½
Mathematics	6
Divinity	2
History	2
Drawing	1
	25½

Lower School.

Upper Third.

Classics	12½
Mathematics	4
History	2
Divinity	2
French	3
English	2
	25½

Lower Shell.

Classics	11½
Mathematics	4
History	2
Divinity	2
French	3
English	2
Singing	1
	25½

Lower Third.

Classics	12½
Mathematics	4
History and English	3
Divinity	2
French	3
Drawing	1
	25½

Upper Second.

Classics	10½
Mathematics	4
History	2
Divinity	2
French	3
English	3
Singing	1
	25½

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Monday,	10–11 a.m., middle division A, modern school	*Chemistry.*
„	11–12 a.m., middle division B. modern school	*Chemistry.*
„	4.15–5.15 p.m., upper shell form	*Chemistry.*
„	5.30–6.30 p.m., lower voluntary form, consisting of about 10 boys from the upper shell, and from each of the two upper fourths (A and B)	*Electricity.*
Tuesday,	12–1 p.m., upper div. mod. school	*Chemistry.*
Wednesday,	4.15–5.15 p.m., upper fourth A	*Chemistry.*
„	5.30–6.30 p.m., upper voluntary form, chiefly from the middle and two lower fifths	*Electricity.*
Thursday,	10–11 a.m., upper div., mod. school	*Electricity.*
„	12–1 p.m., mid. div. A., mod. school	*Electricity.*
Friday,	10–11 a.m., Woolwich class	*Heat.*
„	4.15–5.15 p.m., upper voluntary form	*Chemistry.*
„	5.30–6.30 p.m., upper fourth B	*Chemistry.*
Saturday,	10–11 a.m., mid. div. B., mod. school	*Chemistry.*

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?—The age of those boys who study science varies between 13 and 19, an average age would perhaps be 16. The actual number of boys who do science is at this time 202, of these 47 do only one subject a week (1 hour chemistry); 155 do two subjects a week (1 hour chemistry and 1 hour electricity), while the Woolwich class, numbering 17, do three subjects a week.

Question 6. Amount of knowledge required before the study of science is commenced?—Science is commenced here:—

(A.) In the upper school when a boy enters one of the upper fourth forms.

(B.) In the modern school when a boy enters the middle division B.

Hence no special knowledge is required before a boy can enter the science zone, because he enters it and a new form simultaneously, the commencement of science being determined by his removal into another form.

If a boy shows any very special aptitude for science, and is in a form below the science zone, he is permitted sometimes, by the grace of his form master, to attend science lectures with the upper fourth A or B form, once or twice a week.

Question 7. Is any alternative or choice of subjects offered?—In the fifth forms a boy may choose between verses, history, and science. In the upper shell and upper fourth (A and B) forms, a boy may choose between verses, history, French, and a second non-compulsory hour of science work.

What departments of science are preferred?

a. By parents?—Parents very rarely indeed express any choice in the matter.

b. By the boys?—Physics proper seems the preference by the boys. The note books and general interest would seem to prove that electricity, magnetism, &c., are more popular than chemistry, and easier to comprehend.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—Chemistry receives most attention here, and I believe elsewhere. I cannot say what branch of science has the greatest educational value. I should think, as matter of individual opinion (not of experience), the following subjects would be most valuable:—

a. For young boys:

Elementary botany.
„ chemistry.
„ mechanics, pneumatics, hydrostatics, and hydraulics.

---

* Sometimes an English lesson.

b. For boys between the middle fourth and the fifths :
Elementary heat.
" electricity.
" magnetism.
" sound.
" light.
" chemistry.

c. For boys in and above the fifths :
Mechanics, electricity, magnetism, heat, chemistry.
Elementary astronomy.
Elementary physiology.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—There are marks assigned to each boy who does science, both in his weekly work and in quarterly examinations. These marks are added into the total to assign his final place. The exact proportion observed in adding the science marks to those attained in other subjects probably varies to a certain extent in different forms; but in every form a boy would gain very considerably by having really distinguished himself in the science work.

Methods of Teaching.

Question 10. What proportions of the lessons take the for respectively of—

(*a.*) Oral teaching and demonstration?—The science work here consists of experimental lectures. Questions are asked at the commencement of the lecture, and the boys are invited and desired to ask questions as often as possible out of school.

(*b.*) Book work?—In the middle divisions A and B of the Modern School, Roscoe's Science Primer, and Balfour Stewart's Primer respectively are prepared as form work, and portions of them are discussed before lecture.

(*c.*) Practical work?—As science has not yet been long introduced into the school curriculum, and we have not as yet been able to provide a regular laboratory, practical work is only possible to any great extent in the various branches of natural history.

Question 11. Which form of lesson is found to be most effective?—Lectures, so long as they be of such interest that the attention of the form is well maintained upon the subject.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Except in the instances mentioned (*v.* par. 10. *b.*), the possession and use of text-books is not compulsory.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—The use of note books is required both during and after lecture. Rough pencil notes are expected to be taken during lecture, and these are written out afterwards, and ought to be enlarged from memory, in a fair copy note-book.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Prizes are yearly given for various Natural History Collections *e.g.*, wild flowers; anatomised plants; land and freshwater shells; butterflies, moths, &c.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?—Series of lectures have from time to time been given by different masters on geology, animal physiology, botany, &c., with satisfactory results in increasing the stock of knowledge possessed by a good many boys, and giving a marked stimulus to a few.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

There is a good lecture room with apparatus, a museum, and a botanic garden. Owing to special circumstances it is not easy to say how much they cost; the expense of maintaining them does not in general exceed 30*l.* or 40*l.* a year.

Question 17. Number of assistants and curators, and annual cost?—There is only one regular science master; but several of the other masters assist the boys, especially in natural history, physical geography, &c.

The salary of the science master is about 300*l.* a year.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—*See* Question 16.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—There is a workshop close to the College, fitted up by a tradesman in the town. Boys are encouraged to learn turning, &c., under his guidance, and it is our intention to build a good and commodious workshop within the College grounds at the earliest possible opportunity.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—

For junior classes :
"Roscoe's Elementary Chemistry Primer."
"B. Stewart's Elementary Physics Primer."

For senior classes :
"W. A. Miller's Elementary Chemistry."
"Privet-Deschanel's Natural Philosophy."

For special pupils :
"Ganot's Smaller Physics."
"Huxley's Elementary Physiology."
"Tyndall on Heat as a Mode of Motion."

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There are house libraries, and there is an excellent general library to which boys have free access, and which contains some good scientific books.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—A natural history society, the earliest, I believe, that was founded at any public school, has been in active operation for a considerable number of years. One of the masters is president; other masters frequently attend and read papers. A large number of boys belong to it. There are fornightly meetings, at which papers are read, very often by the boys themselves. There are various sections (geological, botanical, entomological, archæological, &c.), each of which is presided over by one of the members, and which furnish quarterly or more frequent reports. There are one or two field-days every term; on these days the boys go to explore new districts beyond the reach of an ordinary walk. The influence of this society on the boys is in all respects most valuable, and the extent of practical work which it has effected may be judged by the long series of published reports, as well as by the flora of the district, and full accounts of its entomology, geology, ornithology, &c., it has produced.

Tests of Progress.

Question 23. How often is the work tested?—There is a quarterly examination. Note books are then examined, and a paper of questions given. But progress is more or less tested every week by the questions before lecture. When a boy answers badly, his note book is examined, and if insufficient is filled up out of school or re-written.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—By each and every of these means; *vide* preceding paragraphs.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Thus far, except on one occasion, by the teacher of the subjects; but we shall in future take every opportunity that occurs to secure an inspection or examination of our science teaching by competent examiners, unconnected with the school.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—Men, with sufficient knowledge to teach are easily procured; but we cannot be always certain of finding gentlemen who also have the important gift of being able to impart their knowledge, and to maintain the necessary discipline.

Question 27. Where are the best obtained? Have they been specially trained for the work, and, if so, in what does such training consist?—Masters, competent to teach one or other branch of science, can now be found at both Universities. The possession of sufficient knowledge is, however, the smallest part of the matter. Out of a hundred men who know enough of science to qualify them as instructors, there might not be a dozen who would make really good masters; and unless they knew how to teach and to rule, their knowledge would be valueless for all practical purposes.

Question 28. What evidence of scientific ualification tendered by candidates is found to be of most value?—Beyond the evidence of testimonials, published works, &c., I should always try to obtain some private trustworthy opinion of a candidate's qualification before appointing him to a science mastership. Further, I should always think it almost essential that he should have had some experience in teaching, and should give some promise of being likely to possess the qualities that a teacher required.

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

The only results I can give are the averages of marks obtained at the last examination. Max. = 100.

Upper voluntary (from the fifths)	Electricity	59·14
,, ,,	Chemistry	35·55
Upper shell ,,	,,	31·48
,, fourths (A) ,,	,,	29·31
,, ,, (B) ,,	,,	26·16
Lower voluntary (from three preceding forms)	Electricity	42·03
Upper division modern school	,,	49·50
,, ,,	Chemistry	26·07
Middle division ,,	Electricity	36·58
,, ,,	Chemistry	17·90
Lower division ,,	Electricity	24·41
,, ,,	Properties of Matter	35·05
Woolwich class	Heat	36·07

Science has been introduced too recently to have produced any marked results at present. I cannot trace any influence which it has exercised on the general studies or on the intellectual life. There are, however, two good results which it is producing now, and will produce more and more. 1. It enlarges the range of knowledge and intelligent interests for a large number of boys. 2. It has succeeded in stimulating and evoking the powers of a few boys who had failed completely in other studies. These results alone are amply sufficient to justify its introduction, and encourage us to persevere.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—There are as yet no natural science scholarships, but prizes are freely given to reward success or effort in the acquisition of scientific knowledge.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—We are anxious to build a laboratory as soon as our means allow us to do so, and we wish to have our own workshops. Further than this nothing can be at present effected consistently with the character and avowed aims of the school. My experience here has been that the demand for scientific teaching is entirely, or almost entirely, limited by the actual practical requirements of the boys. It seems to be impossible at an ordinary public school to furnish any but a very small number of boys with anything that could be fairly called a thorough education in science. In all the various competitive examinations for which the majority of them are being trained, the part occupied by science is very subordinate to that claimed by literature. Now and then we find a boy with marked scientific aptitude, and it would be our object to stimulate and help him to the utmost of our power; but the practical need of most boys, as well as the express wishes of their parents, render it impossible for us at present to extend the science teaching without injuring the school.

Question 32. What are the principal obstacles to the teaching of science in your own school?

1. The fact that the boys' time is already *absorbed* by studies which have of late years been largely multiplied, and which in most cases they know to be essential to their future prospects in life.

2. The fact that the demand for scientific teaching among parents is very small. The general opinion seems to be that an ordinary knowledge of science does not open the way for any career in the future, and that a boy is more likely to win for himself a future position by following the studies which form the main curriculum of teaching.

Question 33. How could the Universities best assist science teaching in schools?—I do not think that they could do so more than they do at present. The scholarships already founded often fail to produce even a small number of properly qualified candidates. The conclusion to which I have been most strongly led by experience is this,—that the cause of scientific education would be best served by the founding of a school in which science would occupy the *chief*, and literature a *subordinate* place. If such a school were properly endowed, and if Government undertook to provide some career for a certain number yearly of the most successful students; if, too, the school were made a thoroughly good one in all other respects, if it were directed by vigorous and able masters, and furnished with all the best appliances, I believe that much more would be done for the furtherance of real science than the comparatively trivial and not very successful efforts which some schools have made to introduce science into their ordinary course.

Question 34. Can you suggest any way in which Government could assist science teaching in schools, as for example, by inspection?

(*a.*) By setting aside a building at South Kensington, or elsewhere, in which the finest modern physical apparatus could be seen, such as the collection of the Conservatoire des Arts et Métiers in Paris, or the Physical Cabinet in Leyden.

(*b.*) By the grant of moneys for the purchase of apparatus and diagrams, or the loan of such apparatus, or the authorisation of the sale of such apparatus at cost price, and by accredited agents.

(*c.*) By making some branch of science compulsory in all Government examinations.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—I believe from the comparative newness of the study that we are not in a position to speak with any definiteness concerning the general results to be expected from the introduction of science teaching into schools. There can be no doubt the study ought to be generally introduced into all primary and artisans' schools for the better informing of our iron smelters, glass workers, dyers, and handicraftsmen.

Up to the present time it cannot honestly be said either that science has flourished at the public schools, or that we have solved the immense difficulties of organising the teaching of science in such a way as to produce results at all commensurate with the hopes which led to its introduction. The real causes of this are:—i. That the ground is already pre-occupied by a multitude of studies which imperatively demand a place, and which are more generally required by parents. ii. That the introduction of science is still looked on by many teachers as a disturbing element in the progress of the ordinary studies. The real solution of our difficulties belongs, I believe, to the future, and it may possibly be found in the *separate* rather than the *combined* existence of scientific and literary schools. I of course assume that in scientific schools *some* literature would be taught, and in literary schools *some* science, but I think that there should be in England some schools in which the scientific element distinctly predominates, just as the literary element distinctly predominates in most schools at present.

F. W. Farrar, B.D., F.R.S.
Oct. 8, 1872. Head Master.

---

4. Rossall School.

General Arrangements.

Question 1. How is the school classified?—The school is divided into two distinct departments—the Classical and the Modern School. The difference in the courses of education provided in the two departments may be understood from a comparison of the accompanying lists of subjects of study:—

Classical.	*Modern.*
Greek and Latin Books.	Arithmetic and Algebra.
Exercises.	Geometry.
History and Geography.	Higher Mathematics.
Arithmetic.	English Language.
Mathematics.	French.
French.	German.
German.	Latin.
Drawing.	History and Geography.
Music and Singing.	Chemistry.
Writing.	Writing and Book-keeping.
	Music.
	Drawing.

The Modern Department is divided into—
Upper A.
Lower A.
Upper B.
Lower B.

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?—Science is a necessary part of the school course in the Modern Department, but is open to volunteers from the Classical.

Question 3. Copy of time table:—
Chapel at 7 a.m.
Breakfast at 7.20 a.m.
First School at 8.30 a.m. to 10.30 a.m.
Second School at 11.0 a.m. to 12.30 p.m.
Dinner at 1.30 p.m.
Third School at 4.0 p.m. to 6.0 p.m.
Tea at 6.0 p.m.
Preparation at 7.0 p.m. to 8.15 p.m.
Chapel at 8.30 p.m.
Bed for Middle and Lower Schools at 9.0 p.m.
Bed for Upper School at 10.30 p.m.

Rossall School Time Table, 1872.

1st School 8.30 to 10.30 a.m.
2nd School 11.0 to 12.30 a.m.
3rd School 4.0 to 6.0 p.m.
Sunday 9.45 to 10.0 a.m. and 4.0 to 5.0 p.m.

	Sunday.		Monday.			Tuesday.		
	A. M. School.	P.M. School.	1st School.	2nd School.	3rd School.	st School.	2nd School.	3rd School.
Monitors Upper Lower	Greek Testament	Greek Testament	Classics	Mathematics	Classics	Classics	Classics	Mathematics
Probationers Upper Lower	Articles	Paley and Greek Testament.	Classics	Mathematics	Classics, History (1) (1 I.)	Classics	Classics, French	Mathematics
A. Upper	Articles	Paley and Scripture	English Language, Algebra.	Science	German, French	French, Statics*	Geology,* Drawing	Geometry, Trignometry
V. Form Upper Lower	Scripture	Greek Testament	Mathematics, Classics Classics, Mathematics	Classics	Classics	Classics	Mathematics Classics	Mathematics Mathematics
IV. Form Upper Lower	Divinity	Greek Testament	Mathematics Classics	Classics Mathematics	Classics	Classics, German French, Classics	Mathematics Classics	Mathematics
A. Lower	Articles	Paley and Scripture	English Language, Algebra.	Science	German, French	Euclid, Statics*	Book-keeping, Drawing	Geography, Arithmetic
III. Form Upper Lower	Divinity	Greek Testament	Classics	German, Classics Classics, German	Mathematics, Classics Classics, Mathematics	Mathematics, Classics Classics, Mathematics	Classics	French, Classics Classics, French
Modern B., Upper	Catechism	Scripture	French, Mathematics	Classics, N. L. French	Classics	Drawing School, Euclid	French or Mathematics	English Language and Drawing School.
II. Form Upper Lower	Divinity	Scripture	French, Classics Classics	Classics	Mathematics, Classics Classics, Mathematics	Mathematics, Classics Classics, Mathematics	Classics	French, Classics Classics, French
Modern B., Lower	Catechism	Scripture	Mathematics, French	Classics	English Language, German.	Euclid, Drawing School	French or Mathematics	Classics
I. Form Upper Lower	Catechism, &c.	Scripture History	Classics* Classics*	English, French English, French	Mathematics, Classics Classics, Mathematics	Mathematics, Classics Classics, French	French Classics	History, Classics History, Classics
Lower School Upper Remove Lower Remove	Catechism	Scripture History	Classics French	Classics	Arithmetic Drawing	Geometry Classics	Classics Arithmetic	Writing Geography
Preparatory Form III. Upper II.		Scripture History New Testament, Catechism.	Mathematics	Classics Classics	English English	Classics Classics	Mathematics Mathematics	English, Geometry English, Geometry
Lower II. I.		New Testament, Catechism.	Writing.	English English	English Mathematics	Classics Classics, Writing	Mathematics English	English English, Mathematics

* Drawing.

ROSSALL SCHOOL TIME TABLE, 1872—*continued.*

	WEDNESDAY.			THURSDAY.			FRIDAY.			SATURDAY.	
	1st School.	2nd School.	3rd School.	1st School.	2nd School.	3rd School.	1st School.	2nd School.	3rd School.	1st School.	2nd School.
Monitors Upper Lower	Mathematics	Classics	Classics	Classics	Classics	Mathematics Classics	Classics	Mathematics	Classics	Classics	—
Probationers Upper Lower	Repetition, Mathematics.	(2.) Classics	(3.) Composition	Classics	Classics, German	Classics, German (1.)	Classics	Mathematics	History	Classics	Classics.
A. Upper	Classics, German (1.)	Euclid, Viders	Science	French, Trigonometry.	Land Surveying, Drawing.	Arithmetic Statics } Eng. Lit. (alternately.)	Algebra Statics } Conics (alternately.)	Cicero, French, Geology.	Revision examination. English Lang. English Lit. (alternately.)	French, Arithmetic.	Cicero, French.
V. Form Upper Lower	Classics	Classics German, Classics	Classics	Mathematics, Classics. Classics, Mathematics.	Classics	German, French Preparation. French Preparation, French.	French, Classics Classics, Mathematics.	Classics	Natural Science, Classics.	Mathematics, Classics. Classics, Mathematics.	Classics.
IV. Form Upper Lower	Classics	Classics Classics, German	Classics	Mathematics, Classics. Classics, Mathematics.	Classics, German German, Classics	Classics	Classics Mathematics, and Classics.	Classics	Natural Science and Classics.	Mathematics. Classics. Classics, Mathematics.	French, Classics.
A. Lower	Classics, German (1.)	Euclid, Viders	Science	Algebra, French	Bookkeeping, Drawing.	Arithmetic Statics } Eng. Lit.	Algebra. Statics } French (alternately.)	Cicero, French Geology.	Revision examination. English Lang. English Histy. (alternately.)	Arithmetic, French.	Cicero, French.
III. Form Upper Lower	Classics, Natural Science.	Mathematics Classics	Classics	Classics	Classics Mathematics	Mathematics	Classics Mathematics, Classics.	French, Classics Classics, French	Classics	Classics	Mathematics, Classics.
Modern B., Upper	German, English Language.	Mathematics	Science	German, Euclid	French	Mathematics	Classics, Euclid	Mathematics	Drawing School, Special French	Science, English Language.	Mechanics.
Form Upper Lower	Classics	Classics Mathematics	Classics	Classics	Mathematics Classics	Mathematics	Writing Classics } Classics	Classics	Classics Classics, French	Classics Classics, Writing	Mathematics, Classics.
Modern B., Lower	Geography, Drawing School.	Mathematics	Dictation, English Grammar	Euclid, German	Mathematics	French, Geography.	Classics	Science	Drawing School, Special French	English, Science	Mathmcal. Paper.
I. Form Upper Lower	Classics, English Classics, English	Mathematics Classics	English English	Writing, Classics Classics	Mathematics, Classics. Classics, Mathematics.	Mathematics Mathematics	Classics, English English, Mathms.	English, Classics English, Classics	French, Classics Classics	Classics Classics	Classics. Writing.
Lower School Upper Remove. Lower Remove.	Classics	History	Classics, Dictation	Classics	Classics, Arithmetic	Writing, Arithmetic, Drawing.	French, Classics	French, Classics	Arithmetic	Classics, Writing, Classics.	Classics.
eparatory Form III. Upper II. Lower II. I.	French French French English	Drawing Drawing Drawing Drawing	— — — —	Classics Classics Classics Classics	Mathematics Mathematics Mathematics Writing	English, Classics English, Classics English English, Mathematics.	Classics Classics Classics Classics	Writing Mathematics Mathematics Writing	Classics, English Classics, English English, Mathematics.	Classics Classics Classics Classics	Drawing. — — —

Preparation in subject of ensuing morning for one hour and a quarter every evening except Sundays. Special Chemistry Class (Practical), Tuesday and Thursday afternoons, 2¼ to 4.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

Question 6. Amount of knowledge required before the study of Science is commenced.—No definite rule at present.

Question 7. Is any alternative or choice of subjects offered?

What departments of Science are preferred?

(*a.*) By parents?—Parents exhibit complete indifference to the whole subject, with the exception that they occasionally object to their sons devoting any time at all to it.

(*b.*) By the boys?—Practical Chemistry. Also, in an unscientific manner, Natural History.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—At present Chemistry has been always held to be the chief subject in Natural Science. But as, according to my experience, Natural Science in schools, as an instrument of education, can only be useful in developing the observation, and not the memory, much less the judgment, I am inclined to think that the branches that can be best illustrated by specimens and experiments must really have the greatest educational value. If Science is to be taught as an accomplishment, like conversational French, for practical use, then probably Chemistry and Geology are the most important.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—In the modern side, about 10 per cent. of weekly marks, determining the boys' weekly places, are allowed to the Natural Science lessons.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—The teaching is conducted by lectures accompanied by oral and written examinations.

(*b.*) Book work?—No time is devoted to preparation out of school. Book work is subsidiary to the lectures.

(*c.*) Practical work?—Five or six boys work at practical chemistry in the laboratory for 2½ hours per week.

Question 11. Which form of lesson is found to be most effective?—The practical work, undoubtedly: next to that the oral teaching, when accompanied by, and based upon, constant repetition and examination.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—The text-books are used chiefly as a means of repetition, not at all as a means of preparing for the lesson.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Notes are taken by the boys during the lesson.

No time is devoted by the boys to preparation for the Science classes.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Some boys take great interest in the collection of specimens, but there is no systematic work done, and, with the exception of about six boys, no practical scientific work of any kind in chemistry or physics.

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school?—Geology, to a select class of volunteers, has been very fairly taught during the last quarter by lectures once a week illustrated by diagrams.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?—(Plans and descriptions of these, with statements of their cost and annual expense, should if possible accompany this return.)

There is an observatory containing 4½-inch object glass equatorial, a lecture room, and small laboratory. No regular observations have as yet been made at the observatory.

Question 17. Number of assistants and curators, and annual cost?—The science teaching is conducted by one master appointed for the purpose, but no assistant.

The science master has 140*l.* per annum, rising 20*l.* per annum to 200*l.*, with board and lodging, and, with expenses of laboratory, the cost may be reckoned at about 300*l.* per annum.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—There is the usual apparatus of a laboratory, with plenty of gas and water, and no lack of funds to supply whatever is necessary, whether in the way of new inventions or repair of old instruments.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—There is a workshop under the teaching of the clerk of the works. This is popular, and well attended. There is only bench accommodation for six at a time; but boys, some of high intellectual power and great refinement, will spend two hours a day, play-time, in carpentry. The study of practical engineering, under our chief engineer, is also a matter of considerable interest to boys.

Question 20. What text-books are in use, distinguishing between those for the junior and senior classes?—Roscoe's *Chemistry*; Gill's *Chemistry for Schools*; Page's *Geology*.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There is the school library, to which all books of reference are added as required.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—None at present.

Tests of Progress.

Question 23. How often is the work tested—Once a quarter.

Question 24. In what way? *e.g.*, by examination of note books, or by oral or written questions?—By a written examination, generally conducted by an outsider, and generally with unsatisfactory results.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—By an independent examiner generally. But the difficulty of getting a good science examiner is only equalled by the difficulty of getting a good science teacher.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—Immense. The science masters seem to have learnt their subjects under lectures addressed to men, and probably men all anxious to learn. They have no prescriptive or traditionary forms of teaching boys, and no appreciation of the indifference which the average boy has to all knowledge.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—That is just the question that I am now anxiously considering. I have tried Oxford, and I have tried London. In both cases I was happy enough to obtain the services of a gentleman highly taught, and completely master of the subjects. I have once or twice attended the lectures of the London University M.A. myself, and have found them to be consummate works of art, extremely interesting and entertaining; yet this gentleman has resigned in disgust at the smallness of the results of his teaching.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—A London or Oxford degree I have hitherto considered the best, but I should not mind trying Bonn or Leipsic.

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

(*a.*) A scholar of Rossall is now a Natural Science of St. John's, Cambridge.

(*b.*) Nil.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—Prizes only.

Question 31. What improvements do you think could be effected in the teaching of Science in your own school?—I think we must direct the study more in the direction of observation. Boys must be taught to know by sight and weight the difference between the "Arley" and the "Wigan Four-foot," between "Memel" and "Dantzig," "Old" and "New Red," "Arsenic and Salt." All the theories of combination, number of elementary subjects, doctrines of molecules and atoms of gases, may be reserved till the *savants* themselves are agreed about them.

Question 32. What are the principal obstacles to the teaching of Science in your own school?—(i.) The great inducements held out by the Universities for the study of classics and mathematics. (ii.) The unsettled state of opinion as to what is the aim of the study. (iii.) The instinctive feeling of boys that, as at present taught, Science is not equal to Latin and Greek, or Mathematics, for educational purposes.

Question 33. How could the Universities best assist science-teaching in schools?—By diminishing the disparity between natural science scholarships and the others, or, which I should prefer as an educationist, by abolishing all competitive scholarships.

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?—One way in which Government might help would be to offer us commissions or civil service or colonial appointments for excellence in science studies, anything, in short, to balance the overwhelming attractions of classical and mathematical proficiency as a means of getting a livelihood.

Question 35. Have you any other information to give or suggestion to make likely to be helpful to the Commissioners?—Dixi.

ROBERT HENNIKER,
Head Master.
11th Oct. 1872.

---

5. CITY OF LONDON SCHOOL.

General Arrangements.

Question 1. How is the school classified?—The school is divided into six divisions for scientific instruction, viz.:—

6th form - 5th ditto -	1st division.
4th class - Latin class -	2nd division.
3rd class - 2nd class -	3rd division.
1st class - Grammar class -	4th division.
1st junior class - 2nd junior class -	5th division.
3rd junior class - 4th junior class -	6th division.

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?—Science is a necessary part of the school course.

Question 3. Copy of Time Table:—

1st division	Tuesday	2 to 3 p.m.	(Lecture.)
2nd ,,	Monday	,,	,,
3rd ,,	Thursday	,,	,,
4th ,,	Friday	,,	,,
5th ,,	Monday	10.45 to 12 noon	,,
6th ,,	Thursday	,,	,,

Practical chemistry class, Wednesday 12 to 2.

(N.B.—An occasional lesson of one hour's duration is given in the lower school.)

Subjects Taught.

A. 6th division:—
- (*a.*) Atomic theory.
- (*b.*) Hydrogen, oxygen, nitrogen, and the inorganic compounds formed by their union.
- (*c.*) Physical and chemical properties of air and water.
- (*d.*) Thermometers, barometers, air pump, &c.
- (*e.*) Ventilation.
- (*f.*) Especial attention is paid to the use of aqua-fortis as a test for gold, &c.
- (*g.*) Manufacture of gun cotton and gun powder.

B. 5th division:—
- (*a.*) Subjects mentioned under A.
- (*b.*) Carbon and its inorganic compounds with oxygen and hydrogen.
- (*c.*) Blow pipe, nature of flame, conduction and convection of heat.
- (*d.*) Davy lamp.

C. 4th division:—
- (*a.*) Subjects under A and B.
- (*b.*) Sulphur.
  Phosphorus.
  Chlorine.
  Bromine.
  Iodine.
  } And their compounds with O and H.
  Especial attention is paid to their uses as re-agents.
  Fluorine, hydric fluoride, hydric hydrofluosilicate.
- (*c.*) Especial attention is given to the manufacture of oil of vitriol and hydrochloric acid.

D. 3rd division:—
- (*a.*) Subjects mentioned in A., B., and C.
- (*b.*) The common metals.
- (*c.*) Especial attention being given to the metallurgical processes for obtaining iron, copper, lead, zinc, silver, mercury, tin, and gold.
- (*d.*) Manufacture of wrought-iron and steel, tempering steel.
- (*e.*) Manufacture of the common pigments.

E. 2nd division:—
- (*a.*) Subjects mentioned in A., B., C., and D.
- (*b.*) Alkalies and alkaline earth.
- (*c.*) Heat.
- (*d.*) Frictional and voltaic electricity. } Especial attention is given to electric telegraphy.
- (*e.*) Magnetism.
- (*f.*) Outline of theoretical chemistry, qualitative analysis.

F. 1st division:—
- (*a.*) Organic chemistry.
- (*b.*) Higher branches of inorganic chemistry and experimental physics.

Boys are prepared for special examinations in physical geography, zoology, and botany, &c., &c.

In addition to the before-mentioned class-lessons, the practical chemistry class work should not be forgotten.

The three best boys in each of the nine higher classes have the privilege to join this class.

The class generally has about 30 instead of 27 boys.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

For a summary of hours per week see "Time Table" and "Subjects Taught."

A few boys in each division avail themselves of the half hours (12 to 12.30 and 3 to 3.30) for trying some of the experiments shown at the lectures. The half holiday is utilized for the practical work. Boys are also helped (during playtime) to prepare for the various Science examinations at Kensington, &c., &c.

The Science exercises have to be prepared sometime during the week.

The junior divisions have a lesson of one hour and a quarter once a week.

The upper divisions have a lesson of one hour once a week.

An occasional lesson is given in the lower school.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

—		No. of boys this term.	Average age this term.
1st division	6th form - - -	27	17
	5th ,, - - -	24	$15\frac{3}{4}$
2nd division	4th class - - -	36	15
	Latin class - -	50	$14\frac{3}{4}$
3rd division	3rd class - - -	61	$14\frac{1}{2}$
	2nd class - - -	64	$13\frac{2}{3}$
4th division	1st class - - -	85	$13\frac{5}{8}$
	Grammar class - -	97	$13\frac{1}{2}$
5th division	1st junior class - -	70	13 nearly
	2nd junior class - -	57	$12\frac{2}{3}$
6th division	3rd junior class - -	49	$10\frac{3}{4}$
	4th junior class - -	47	$10\frac{1}{6}$

Question 6. Amount of knowledge required before the study of Science is commenced.

Writing,
Reading,
And multiplication table.

Question 7. Is any alternative or choice of subjects offered?—No.

What departments of Science are preferred?

a. By parents?—As a rule, chemistry.

b. By the boys?—Practical chemistry and electricity.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—Chemistry (for the lower school), and chemistry and physics (for the higher school).

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—

1. Class promotion is not at present influenced by scientific attainments, but a change in this respect is on the point of being made.

2. Prizes are given.

3. Science counts in the general scholarships of the school.

Methods of Teaching.

Question 10. What proportions of the lessons take the from respectively of—

(*a.*) Oral teaching and demonstration?—All the school work (1 hour to 1¼ hours).

(*b.*) Book work?—Home work (about ¾ of an hour).

c.) Practical work?—Answered in Nos. III. and IV.

Question 11. Which form of lesson is found to be most effective?—I am of the opinion that a combination of—

(1.) Oral teaching with demonstration;

(2.) Book work; and

(3). Practical work, will be found the most effective form of lesson, but I am unable to form a comparison, as in no division of this school is the teaching exclusively confined to any one form. The class for practical chemistry at the City School of course shows to the greatest advantage, as it is composed of the most advanced boys from each of the upper divisions.

Question 12. How are text-books used? *e.g.*, is book work supplementary or preparatory to the oral lesson?—Supplementary.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Boys are *obliged* to use note books during the lesson, and encouraged to use them in preparing their home lessons, &c.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—The boys belonging to the practical chemistry class entirely prepare their own apparatus, but are not obliged to either prepare the experiments or to collect specimens during the intervals between lessons. They are, however, encouraged to try experiments both at school and at home, and also to collect "specimens."

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school?—In each branch of Science taught here the course pursued is as follows, viz.:—

A lecture is given, and the boys have to take notes. At the end of the lecture a short *viva voce* examination takes place.

For "home work" the boys have to write answers to certain questions on the subjects treated of in the lecture. These answers are brought on the next lesson day.

In the lower school the boys have to bring drawings of the apparatus and experiments shown at the lecture. Boys who take an interest in the subject are encouraged to remain after the lesson to receive extra instruction, and to try the experiments for themselves.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.), is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with strtements of their cost and annual expenses, should, if possible, accompany this return.)

A lecture room (which is also used as a laboratory by the boys of the practical chemistry class); also a private laboratory. I cannot furnish you with the cost, but the accompanying plans may give you some idea.

Question 17. Number of assistants and curators, and annual cost?—One principal teacher, 180*l.* (at present rising 10*l.* per annum to 200*l.*)

One assistant, 60*l.*

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—30*l.* is allowed yearly for new instruments and to replace materials used. The apparatus is such as is generally employed to illustrate the various points (in chemistry and physics, &c.) which are brought before the pupils. A better idea than could be given by a report (necessarily so limited), would be obtained by personal inspection.

Question 19. Is there a workshop? and if so, how, and for what particular purpose is it used?—No.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—

Junior {
Hall's Chemistry.
Buckmaster's Chemistry (Inorganic).
Ferguson's Electricity.

Senior {
Tate's Heat, &c.
Balfour Stewart's Elementary Physics.
Jarmain's Qualitative Analysis.
Fownes' Chemistry.
Miller's Chemistry.
Ganot's Physics.

Senior {
Brook's Natural Philosophy.
Oliver's Botany.
Carpenter's Animal Physiology.
" " Vegetable "
Lyell's Geology.
Lardner's Handbook of Natural Philosophy (4 vols).

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—Boys in the 6th form can obtain admission to the Guildhall Library.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—There is none.

Tests of Progress.

Question 23. How often is the work tested?—Twice a year by a written examination; also by the *viva voce* examination at the end of each lesson. (Also by occasional inspection of note books.)

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?

(1.) By examination of note books.

(2.) By oral } questions.
(3.) By written }

(4.) By practical work.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Once a year by the public examiner, John Spiller, Esq., F.C.S., late assistant chemist to the War Department. At other times by the teacher.

Teachers.

Question 26. Is there any difficulty in procuring competent Science Masters?—I have not experienced any.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—From the Government Science School, Royal School of Mines, and Royal College of Chemistry, &c., &c.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—The most valuable evidence of "scientific qualification," as distinct from teaching qualification, would be evidence forthcoming from the professors in the foregoing institutions.

Question 29. Can you state any results of Science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

Yes. A list has already been forwarded to the Royal Commission on Scientific Instruction and the Advancement of Science, to which you will perhaps kindly permit me to refer you. I would also mention that the list which was sent to the Royal Commissioners on 19th September. 1870, employed me during my spare time for upwards of a fortnight.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?—Yes. One exhibition, value about 14*l.* 10*s.*, tenable for one year; one silver medal; and 24 prizes (total value 10*l.*). Science also counts in the regular scholarships of the school.

Question 31. What improvements do you think could be effected in the teaching of Science in your own school?—I would suggest the following alterations:—

(1.) Chemical proficiency to count in class promotion.

(2.) An hour's oral teaching with demonstration, followed by an hour's book work, and supplemented by practical work. This would of course necessitate—

(3.) More time to be devoted to the study of Natural Science; and

(4.) More assistants.

(5.) More valuable exhibitions and prizes to be given for proficiency in Natural Science.

Question 32. What are the principal obstacles to the teaching of Science in your own school?—The necessarily limited time given to the study of Natural Science.

Question 33. How could the Universities best assist Science-teaching in schools?—By offering valuable exhibitions, and by recognising the Natural Siences as a regular subject in pass and entrance examinations.

Question 34. Can you suggest any way in which Government could assist Science-teaching in Schools, as, for example, by inspection?—Yes,—

(1.) By inspection (if not carried to excess) by one experienced in teaching.

(And 2.) By awarding prizes.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—That the pupils of the City of London School (and the like) should be allowed to take the prizes and medals awarded by the Science and Art Department (South Kensington), but at present limited to the students of Government Science classes. Also that the list of successful candidates be published.

I understand that there has been a great falling off in the number of the pupils that have presented themselves from this school for examination at South Kensington, since the medals and prizes were limited to the students from Government Science classes.

EDWIN A. ABBOTT,
14th October 1872. Head Master.

---

6. WINCHESTER COLLEGE.

General Arrangements.

Question 1. How is the school classified?—The main division is into four blocks, called—

(A.) Sixth Book of 60 (in round numbers.)
(B.) Senior Part V. of 110 " "
(C.) Middle Part V. of 150 " "
(D.) Junior Part V. of 60 " "

These blocks are subdivided for the several subjects of study, as follows, into the following numbers of classes:—

	A	B	C	D
For Classics into	2	4	5	2
" Mathematics	6	7	10	4
" Natural Science	1	4	0	0
" Modern languages	3	4	6	2

There are two modern classes besides, one ranking with B, the other with C.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Science is taught—

1. To boys in sixth book who have evinced special capacity for it, or who desire it themselves, or whose parents wish it. They amount to about a fourth of the number.
2. To all the boys in Senior Part V. This provides for boys who attain a fair position in the school two years' teaching while in this part of the school as a necessary part of their school work.
3. To the two modern classes.

Question 3. Copy of time table.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

	A	B	C	D	Modern.
Classics	10	9	9	10	2 4
Mathematics	4	4	4	4	6
Modern languages	2	2	3	2	6
English subjects	2	2	3	4	4
Natural Science	2	2	—	—	2
Drawing	—	—	—	3	—

Composition is done besides this. Preparation has 20 hours provided in school times, and boys must usually find an hour a day for work besides out of time at their own disposal. About eight hours a day is the average work.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

1. Mechanics and hydrostatics, sixth book. No., 12. Age, 17.
2. Geology. No., 30. Age, 17.
3. } Physical geography. { No., 40. Age, 16.
4. } No., 40. Age, 16.

Question 6. Amount of knowledge required before the study of science is commenced?—With the exception of the junior modern class, the boys who are taught science are in the higher parts of the school, and fairly advanced in classics and mathematics.

Question 7. Is any alternative or choice of subjects offered?—No, the classes have their subjects fixed.

What departments of science are preferred?

a. By parents?
b. By the boys?—I do not think any one branch is generally preferred to others. Some like one, some another.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?

1. That of the surface of the earth.
There is always a class in geology.
In summer several in botany.
Other branches of physics are taken in a cycle.

2. I do not think there is any special educational value in the lessons different from what is derived from lessons in other subjects given in the same way.

The geological and botanical courses, which cause actual acquaintance with specimens, are the only ones that seem special.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—About one tenth of the whole marks in class work and examinations.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—In the lower classes, the whole. In the two highest this is combined with book work.
(*b.*) Book work?
(*c.*) Practical work?

Question 11. Which form of lesson is found to be most effective?

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Supplementary.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Notes are required and taken during the lesson and written out after it. In all but the highest class they are encouraged by marks weekly in an effective degree.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used? (Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)—A special lecture room fitted for the purpose. A room for a museum and for the use of boys who collect objects of natural history.

Question 17. Number of assistants and curators, and annual cost.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for instruments, and to replace materials used, &c.?—

Mechanical models.
Elementary electrical apparatus.
Apparatus for illustrating physics.
Botanical plates.
Maps and globes.
Geological specimens.
Botanical collections.

Question 19. Is there a workshop? and, if so, how and for what particular purpose, is it used?

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes.—They have varied. Ganot's *Physics* and Page's *Geology* are two which would represent them.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—A Natural History Society, limited to 50 boys, who adopt the members. It meets once in three weeks. Two masters help to manage it. Boys read papers, and collect and exhibit specimens.

In summer it gives a number of boys an interest which has been quite real and good.

The lists of plants and insects collected are growing satisfactorily.

Mr. Griffith has created a considerable geological interest, and some boys have made good collections here and at home.

Tests of Progress.

Question 23. How often is the work tested?

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—In both these ways.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Written examinations are held,—

1. By the teachers several times a term.
2. By independent examiner once a year.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—Yes.

Question 27. Where are the best obtained? Have they been specially trained for the work; and, if so, in what does such training consist?—Our teachers are from Oxford and Cambridge. They have not been specially trained for the work.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of science teaching in the school? such as—

(*a*.) Success, professional or otherwise, of individual scholars.

(*b*.) Influence upon the general studies and intellectual life of the school.

(*a*.) Several boys have gained University distinctions in Natural Science at Oxford.

I cannot feel that the individuals who are carrying their studies further were led to do so by their school teaching, but by personal or professional interest in them.

(*b*.) I think there has been an interest created in botany and geology, which has altered the feeling of contempt for such things which used to be general.

I do not think it affects the other studies of the school either way.

The principal result is a more general spread of sensible estimates of the value of such knowledge. I don't expect to find individuals do more than *e.g.*, Messrs. F. Buckland and P. Sclater, who were at the school when no regular teaching was given in science.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes), open to successful students of science in the school?—Prizes are given by Lord Saye and Sele for each of the classes in Natural Science.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—We are at present in such an elementary condition in regard to science teaching that the improvements possible in it, if it is settled that this is a school where it should be made a main branch of study, are endless. They would, *e.g.* involve the entire construction of a system of practical teaching and work.

For the purpose of communicating the outlines of general knowledge of some branches of Natural Science in a popular way, and of starting interest and acquaintance with scientific ideas, our courses answer their purpose.

Question 32. What are the principal obstacles to the teaching of science in your own school?—Those incident to a period of transition,—

1. The costliness of starting it, especially in such a branch as chemistry.
2. The difficulty of finding teachers possessing actual knowledge of practical and experimental kinds, who are also able to manage a class of boys.
3. The past feeling of inferiority to other subjects, a feeling, perhaps, hardly past.
4. The feeling that it does not "pay" as well as other subjects.

Question 33. How could the Universities best assist science-teaching in schools?—

1. By making it *essential* for *their best men* to know some rational amount of Natural Science.
2. By framing some definite courses of natural science teaching:—*α*. Of a standard fitted for a boy's main study; *β*. Of a popular standard, fitted to be a universal study for all boys, subordinate in position, but sufficient to give some real knowledge.

Question 34. Can you suggest any way in which Government could assist Science-teaching in schools, as, for example, by inspection?—By carrying into other branches what has been done for botany by the preparation of sets of plates, *i.e.*, by organising a system for supplying sets of typical specimens of zoology, geology, &c.

Nothing but a central organization can ensure schools, which have no special opportunities, the possibility of obtaining the necessary collections.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—The head masters of the principal schools have asked the Oxford and Cambridge Natural Science Boards to draw up outlines of Natural Science teaching fitted for schools, of the two standards mentioned above, and these bodies have consented to do so.

G. Ridding,
Oct. 16, 1872. Head Master.

7. Stonyhurst College.

Stonyhurst College,
Sir, Oct. 16, 1872.

In reply to your letter of the 27th ult., I beg to say that in the *school* or *boys' department* of this College so little Science is taught that it would be useless to attempt to fill up the paper sent, or to ask anyone to come down here on behalf of the Commissioners.

I may say, in brief, that we teach the boys sufficient for them to pass the matriculation examination of the University of London. It is only the highest class that is specially prepared for this.

This class (averaging about 16 in number, and, perhaps, 17 in age) has three hours weekly with a Science master. They are supposed to get up in the intervals what they were taught at their last lecture. The text books in use are Barff's Chemistry and Newth's Natural Philosophy.

There is a laboratory where the boys may make a few experiments, if they wish, under superintendence; but this has not been insisted upon.

The next two classes have one hour a week, just to give them first notions before actually studying for matriculation.

There is no regular teaching in Science for any class below these.

The more thorough and extended study of Science is reserved for young men who are also engaged in the study of mental philosophy. But this is in a department wholly independent of the *school*, and, therefore, I apprehend, not falling in any way within the scope of the Commissioners' inquiry.

I have the honour to be, Sir,
Your obedient servant,
E. J. Purbrick, S.J.
Rector of Stonyhurst.

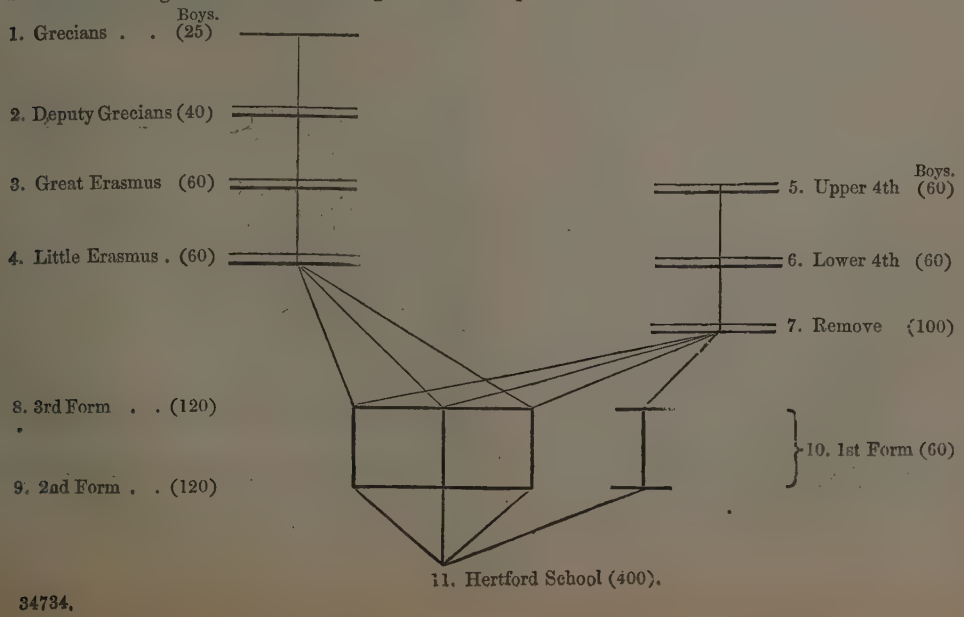
J. Norman Lockyer, Esq.
&c. &c. &c.

8. Christ's Hospital.

Dear Sir, Oct. 17, 1872.

In answer to your questions I have to say:

I. The classification of the school will perhaps be understood from the annexed diagram of the classes in the "Grammar School" or language department, in which every boy (with the exception of the 50 naval boys) passes at least half his school hours.



The horizontal lines denote the several classes. The classes 8, 9, are under three parallel masters. 10 is composed of backward boys, who are older than the average age on coming from Hertford.

Boys pass from 8, 9, into 1–4 as soon as they are fit, but boys who reach the age of 13½ before they are qualified for 4, are draughted from 8, 9, into 7, as are also all boys from 10 on reaching the age of 13½.

The classes 1–4 are intended to fit boys for professional life, 5–7 for commercial life.

[Since 1869 no Greek has been taught in any of the classes except 1–4. Up to that time every boy in the London school had learnt Greek. The time saved from Greek was given to English, French, Latin; and so far as we have gone we see no reason to apprehend that Greek will suffer in the upper classes, as it is very rapidly picked up by boys who have had previously a thorough grounding in language.]

Besides the Grammar School the other chief departments are—

α. The Mathematical School, in which classes 1, 2 spend 9 hours a week, and 3, 5 an average of 6½ hours.

β. The Commercial School (for arithmetic, writing, reading, geography, &c.) to which the classes 3, 5 give an average of 5 hours a week, and 4–10 half their school hours, minus a short time given to drawing.

γ. The Naval School, in which some 50 boys are prepared for sea.

II. Science is a necessary part of the school course.

Every boy in classes 3–6 gives at least one hour a week during half a year to Natural Philosophy (oral lectures with apparatus and experiments), as an introduction to the Chemistry class, in which he stays at least half a year. Those who show any special aptitude are allowed to continue Chemistry, and promoted to the practical class.

Further, the boys in 3 and 5 learn Elementary Mechanics in the Mathematical School as soon as they are qualified by their mathematical knowledge.

In classes 1, 2, Mathematical science (Statics, Dynamics, Hydrostatics, Optics, Astronomy) is studied in preparation for the Universities, and carried to a high point.

The boys in class 10 give one hour a week to very elementary Natural Philosophy (oral lecture with experiments).

III.–IV. I append a copy of the time table, which answers both these questions.

Christ's Hospital, London.

Regular School Work.																Extra Subjects.								
																Compulsory.						Voluntary.		
Average Age.	Class.	Divinity.	Greek.	Latin.	English.	Mathematics.	Arithmetic.	Writing.	History.	Geography.	Dictation.	Reading.	French.	German.	Drawing.	Regular School Work.	Preparatory School.	Gymnastics.	Drilling.	Swimming.	Chemistry.	Natural Philosophy.	Singing.	Instrumental Music.	—
Classical School.																									
17	I.	2	6	9	½	8	—	—	—	—	—	—	2	—	—	27½	—	2	—	—	—	—	2 400 Boys.	2 80 Boys.	From various classes.
15½	II	2½	6	6	½	8	—	—	1⅓	—	—	—	2	—	—	26½	—	2	2	¾	—	—			
																					Upper Half.	Lower Half of the Class.			
15	III.	1	5	5	1½	5¾		1	1¼	¾	½	½	2¾	—	1	26	7½	1	2	¾	2	1			
13½	IV.	1	5	5¼	1½	—	3½	1	1¼	1	1	¾	2¾	—	2	—	7½	1	2	¾	—	—			
Modern School.																									
																					Upper Half.	Lower Half of the Class.			
15½	V.	1¼	—	3¼	4	6½		1	1¼	1¼	1½	½	2½	2	1	26	7½	1	2	¾	2	1			
14½	VI.	1¼	—	3¼	4	—	5½	1	1¼	1¼	1	1	2½	2	2	26	7½	1	2	¾	—	—			
13½	VII.	¾	—	4½	5¼	—	5	1½	1	1	1½	1	2½	—	2	26	7½	1	2	¾	—	—			
Lower School.																									
13	VIII.	1	—	6	3	—	5	1½	1	1	1½	1	3	—	2	26	5	1	2	¾	—	—			
12½	IX.	1	—	6	3	—	5	1½	1½	1½	2¼	1¼	3	—	—	26	5	1	2	¾	—	—			
11½	X.	1	—	3½	3½	—	5	1½	1½	1½	2¼	1¼	5	—	—	26	5	1	2	¾	—	—			

It appears from this that the time given to Natural Science is outside the regular school hours, but as a matter of fact every boy in the senior part of the school has to give one or two hours a week more than the general school hours to some subject or other. All junior boys have about 26 hours a week in school; all senior boys from 27 to 29.

V. Range of age of 1 - - - 16–19.
„ 2 - - - 14–16.
„ 3, 5 - - - 14½–16.
„ 4, 6 - - - 12½–14½.

VI. It will be seen that *in general* a boy's entrance into the Natural Science classes depends on his progress in the Language Department, but no difficulty is put in the way of volunteers who wish to begin earlier.

In general a boy who enters the Natural Philosophy class will have learnt only arithmetic; by the time he reaches the Chemistry class he will have learnt a book or two of Euclid and some Algebra. Before he learns Mechanics he will have read six books of Euclid, Algebra as far as quadratic equations, and some Elementary Trigonometry.

VII. Boys who are preparing for a special career or examination, are often allowed to drop a large part of their classical work, and devote the time to special branches of Mathematics or Science. Thus, at present two boys who are preparing for Cooper's Hill College have given up Latin and Greek composition to study Light, Heat, &c.

VIII. Our experience as to Chemistry and Natural Philosophy is very short, as the classes have been barely two years at work. We attach a very high educational value to the training in Mathematical Science given in classes 1, 2.

IX. Chemistry and Natural Philosophy are allowed no such weight. Mathematical Science in 1, 2 has great weight, and for some of the more important distinctions of the school is ranked on an equality with Classics.

X. Mathematical Science is taught by (*a*), (*b*), and, from the nature of the case, bookwork, or rather working problems and examples on paper, takes a large proportion of the time given to the subject.

Chemistry is taught by (*a*), (*b*), (*c*) in about equal proportions.

Natural Philosophy by (*a*), (*b*) in the ratio of 3 to 1.

Elementary Mechanics is taught orally, and examples are set to be worked from books.

XI. There is no doubt that in all these cases oral teaching by a good teacher is far more effective than any book can be.

XII. In all these subjects the book is supplementary to the oral lesson, and is used to systematise and enforce the oral teaching, and to supply problems and examples.

XIII. In the Natural Philosophy class no note books are used. In Chemistry and Elementary Mechanics they are used during the lesson.

XV. I refer you to Dr. Russell for some account of his method of teaching Chemistry. [*See this at the end.*]

XVI. By the permission of the authorities of St. Bartholomew's Hospital, our Chemistry classes are allowed to make use of their admirable laboratory and lecture room, under the instruction of Dr. Russell.

There is no museum or special scientific lecture room in the school itself.

XVII. Two of the masters voluntarily help Dr. Russell by acting as *répétiteurs* to the Chemistry classes, and one of the Mathematical masters takes the Natural Philosophy class as one of the duties of his post.

XVIII. The Natural Philosophy class has been in existence only two years. Apparatus to the value of some 25*l.* has been supplied, sufficient for the elementary lectures given. No special sum is allowed annually.

XIX. There is no workshop.

XX. I. Mathematical Science:

(α) Todhunter's Elementary Mechanics.
Parkinson's ditto.
Todhunter's Analytical Statics.
Besant's Hydrostatics.
Parkinson's Optics.
Godfrey's Astronomy.
(β) Hamblin Smith's Hydrostatics.
Galbraith and Haughton's Hydrostatics and Mechanics.

II. Natural Science:

(α) Deschanel's Traité de Physique.
Maxwell on Heat.
Tyndall on Heat.
Tyndall on Sound.
(β) Balfour Stewart's Lessons in Elementary Physics.
Balfour Stewart's Science Primer.
Barff's Manual of Chemistry.
(Roscoe & Gill occasionally.)
(α) Senior boys.
(β) Junior boys.

XXI. Books on science suitable to boys are added from time to time to the school library, on the suggestions of masters or boys.

XXII. There is no such society.

XXIII. Progress in every subject is tested by half-yearly examinations, by written questions, and in the Chemistry class by periodical examination of note books.

XXV. Progress in Mathematical Science is tested once a year by an independent examiner.

All the other classes have hitherto been examined by their own teachers.

XXVI.–XXVIII. I have no answer to give to these questions.

XXIX. The Mathematical department has had considerable success at Oxford and Cambridge. *See* Report of Schools' Inquiry Commission, vol. III., pp. 56, 57, and vol. IV., pp. 837, 838.

The other classes are too young for us to be able to state any such results of them.

XXX. The Chemistry and Natural Philosophy classes get their share of the ordinary prizes. A considerable share of the exhibitions to the Universities has always been assigned to good mathematicians. Hitherto no *special* reward has been given to Natural Science, but I am at present trying an experiment which may be a precedent. A Grecian, who showed a marked inclination for Natural Science, has been excused the greater part of his classical and mathematical work, and is attending lectures at St. Bartholomew's, Kensington, and the College of Surgeons, on Physiology, Chemistry, &c. If he satisfies us that his aptitude and progress are commensurate with those of his contemporaries, who are studying classics and mathematics, I shall recommend him to the Governors for an exhibition at Oxford or Cambridge.

XXXI. I intend proposing to the Governors that we should have each spring a course of lectures on Botany (illustrated by specimens given to each boy in the class). I should further wish that the junior classes should have at least one hour a week of oral instruction in some elementary physical subject, treated so as to stimulate their powers of observation and analysis.

XXXII. (1.) Most of the boys leave before 16; at present there are hardly 30 boys in the school over 16. These are all aiming at University scholarships, and hitherto have found Classics and Mathematics the only (or at least the readiest) avenue to them.

(2.) Want of time to fit in Natural Science by the side of the need for French, German, &c. for commercial positions, to which a very large proportion of our boys go off.

(3.) Our position in the middle of London, which shuts our boys off from the many opportunities that country boys have, of observing nature. Recently, when Professor Tennant gave a course of lectures on Geology, several boys contrived to form little collections of chalk fossils from Charlton, but it is obviously difficult to find for them many such opportunities for observation of nature.

(4.) The fact that the teachers of the existing staff are mostly unacquainted with Natural Science, at any rate in such a measure as to be adequate teachers of it.

(5.) The fact that many teachers are without a clear knowledge of the best subjects and methods of teaching Natural Science to boys, *i.e.* of such as have a real *educational value*, which would warrant our substituting them for, or adding them to, proved subjects and methods of education. I myself look hopefully to the Commission for information and guidance on this subject.

XXXIII.—(1.) The most obvious suggestion is, that the Colleges should offer more encouragement in the shape of scholarships and exhibitions, and that the Colleges and the Universities should put Science more on a level with other subjects in their examinations.

(2.) The universities might supply the deficiency of highly-trained scientific teachers by endowing a class of local sub-professors, who should further the teaching of Natural Science in the schools of a given district by lectures, examinations, and inspection, and by their advice and suggestions to the teachers of the several schools with regard to subjects and method of teaching, choice of apparatus, &c.

(3.) If the scheme of organised examinations of schools by the Universities (suggested by the conference of head masters) should be adopted, Natural Science would find its place in such examinations.

XXXIV. The Government could assist in analogous ways:—

(1.) By requiring natural science in its competitive examinations.

(2.) By appointing local inspectors, and further by aiding in the formation of school museums and collections.

XXXV. My experience is but short, but I have found already that the plan often adopted of teaching Chemistry as the first subject, is not satisfactory. I attended an admirable course of lectures given by the late Dr. Matthiessen to a class of our boys, who had had no previous scientific instruction in Natural Science. It was obvious that most of it was lost upon them for want of familiarity with simple scientific notions; and we found it necessary to institute the Natural Philosophy class as an introduction to the Chemistry class.

G. C. Bell, M.A.,*
Head Master of Christ's Hospital.

Chemistry Classes at Christ's Hospital.

There are certain special circumstances affecting these classes which should be first stated; they are that the laboratory and lecture-room in which the classes are held belong to St. Bartholomew's Hospital, and are larger and more complete than such buildings ordinarily are; that very large classes have to be taught, and, lastly, that only a small amount of time is devoted to this subject.

The chemistry class has been established about three years. The late Dr. Matthiessen was the first teacher, but the class was hardly organised when he died. I have had the honour of holding the appointment only about a year and a half, and consider the present system of teaching little more than tentative. Each half year considerable changes have been introduced, and further experience and consideration will undoubtedly suggest other changes. The present report is, therefore, only a sketch of what is now being done here, not an account of the established method of teaching chemistry at Christ's Hospital.

At the present time (October 1872), there are two chemical classes, the junior class, consisting of 49 boys, of the average age of 14·9, and the advanced class, consisting of 21 boys, of an average age of 15·3. Beside these classes, three senior boys are working in my laboratory, and receiving from me special instruction.

---

* These answers represent the state of the School in 1872. Some modifications in details have since taken place.

Junior Class.—All the boys in this class have, during the last half year, attended a class of elementary physics, and commenced the study of chemistry at the beginning of the present half year. The teaching is at first of the most elementary kind; the simpler I have made it, the more efficient it has proved. To commence with, I prefer illustrating, explaining, and making the boys perform some very simple physical experiments, to purely chemical ones, choosing such as are of common occurrrence in chemical operations. For instance, the effect of heat upon water; its rise of temperature; its conversion into a gas, and the recovery of the water from the gas (distillation); then passing on to the solution of bodies in water and the testing for them by evaporation. My special object being to begin with phenomena with which the class are familiar and really believe in, and then to pass systematically to others of a more technical character. A boy cares little about a chemical reaction which he can hardly understand, except it be as a pyrotechnic display, or for some reason of that kind; but if he has seen some salt dissolved in water he will be intensely interested in seeing the solution evaporated to dryness in a platinum basin, and the salt recovered. After studying simple phenomena of this kind, the properties of acids and alkalies are shown, the formation of a neutral salt, and in some detail a chemical change, such as the action of hydrochloric acid on chalk, the experiment being made quantitatively, and the products carefully collected and examined. Thus, gradually the boys gain familiarity with chemical phenomena, and then pass on to the systematic study of chemistry. In all the lectures the boys take notes, time being given them to write down in full the most important points. After each lecture certain of the boys are called upon to give up their note-books, and these are looked over. It is seldom that the notes are not sufficiently full and accurate; if not satisfactory, the boy has to render them complete by reference to the text-book, or to another boy's notes for what is not in the text-book. A *vivâ voce* examination precedes every lecture. At irregular intervals, depending on the subject in hand, the hour is devoted to practical work in the laboratory, instead of a lecture. During last half year the junior class did no practical work, but this half a considerable amount of practical work is being introduced. I feel now little doubt it will prove very advantageous even to the youngest beginner to have a certain amount of practical work introduced into the course of instruction.

In the advanced class the same system of teaching is carried on. The text-book used is Barff's *Chemistry*. The order of the subjects in it is followed, but the teaching is not a precise following of the substance of the book. In both classes I have been very much aided by the Rev. E. S. Carlos and Mr. Mackie, both of them masters in Christ's Hospital, who have volunteered their services and have attached themselves one to each class. They devote one hour a week to recapitulating to their class the subject of the last lecture, questioning the boys on the subject, and giving them further explanation if required.

The features of special interest in these classes are perhaps the large classes taught and the ample accommodation we have for teaching such classes. A practical class of 50 boys is perhaps unknown elsewhere. Notwithstanding its size, it works very satisfactorily; two boys work together and have a complete set of apparatus to themselves. On a day when practical work has to be done, the boys go first into the lecture room, and are shown the exact apparatus they have to use, and exactly how the experiments are to be made; then they pass to the laboratory and make the experiments for themselves. Order, care, and neatness are required from the boys and rigidly enforced, but without the slightest difficulty. In the practical teaching I have found the greatest advantage to arise from making the experiments as quantitative as possible. If they have nitric acid to prepare I give them a known weight of sulphuric acid, and make them calculate out and then weigh out the requisite quantity of nitrate of potash. In studying hydrogen I have made them reduce a known weight of oxide of copper and weigh the water obtained; this gives a definite interest to the experiment; they appreciate the quantitative nature of the reaction; it affords a most valuable check on the care and accuracy with which the experiment has been made, and excites a spirit of emulation to obtain the best results.

The senior boys not belonging to these classes work independently in the laboratory, and follow out their chemical studies, under my direction, in the same way as any other students would do.

W. J. Russell, F.R.S.,
Lecturer on Chemistry at St. Bartholomew's Hospital.
October 30th, 1872.

---

9. Wellington College.

General Arrangements.

Question 1. How is the school classified?—There are two main divisions or schools, the "Classical School" and the "Mathematical" or "Modern School." These are quite parallel and equal in position and status. There is a sixth form in each, and the prefects of the school may be indifferently in either school. Boys are not allowed to enter the Modern School unless they are distinctly qualified to do so. The masters are judges as to this. Boys may be transferred from one school to the other at any point of either school. Those whose classical work is important to their future (or who will, *e.g.*, make classics serviceable in examinations, as Woolwich), but wish to end their work at school with a mathematical training, frequently enter the Mathematical School from the sixth or fifth. Conversely, good scholars in Modern School have some classical lessons with the classical sixth. There are 350 boys:—In Classical School one per cent., 8 in sixth, 19½ upper school, 26 middle school, 13 lower school; in Modern School one per cent., 5 in sixth, 13 upper school, 15½ middle school. For modern languages, mathematics, and science, the forms are rearranged into classes called "sets.'

Classical sixth into - -	2 mathematical sets. 2 German ,, 1 science ,,
,, upper school into - (3 forms.)	4 mathematical ,, 4 modern language ,,
,, middle school into (4 forms.)	5 mathematical ,, 5 modern language ,,
,, lower school into - (3 small forms.)	3 mathematical ,, 3 modern language ,,
Mathematical sixth and upper school into - (3 forms.)	4 mathematical 2 science ,, 1 Greek ,,
Middle school - -	3 mathematical ,,

[Modern languages being basis of form division.]

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Necessary in the classical sixth. Necessary in the mathematical sixth, upper school, and highest form of middle school. There is also a voluntary class in chemistry (practical).

Question 3. Copy of time table?—Enclosed.

CLASSICAL SIXTH.

—	7–8.	9¼–10¼.	10¼–11¼.	11¼–12¼.	12¼–1¼.	2–3.	4–5.	5–6.	Evening, besides preparation of next Morning's Lesson.
S.	—	—	—	—	—	—	Di.	—	—
M.	Di.	—	C.	C.	—	—	—	C.	Exercise.
Tu.	C.	—	C.	M.	—	—	—	M.	[Private Tuition.]
W.	C.	—	C.	G.	—	S.	—	C.	Exercise. Science Notes.
Th.	C.	—	C.	M	—	—	—	—	Exercise.
F.	C.	—	Mod. History read in French.	C.	—	—	M.	C.	—
S.	C.	—	Philology (Comp.)	G.	—	—	—	—	[Private Tuition.]

MATHEMATICAL SCHOOL. SIXTH AND UPPER SCHOOL.

—	7–8.	9½–10½.	10½–11½.	11½–12½.	12½–1½.	4–5.	5–6.
S.	—	—	—	—	—	Di.	—
M.	Di.	—	S. or Gk.	Dr.	Dr.	—	M. L.
Tu.	M.	—	H. or L.	H. or L.	M.	—	M. L.
W.	M.	M.	—	M. L.	—	M. L.	S. or Gk.
Th.	M. L.	M. L.	—	E. or L.	M.	—	—
F.	M.	Dr. (9–10½	—	M. L.	—	M.	M.
S.	H. or L.	—	S. or Gk.	—	M.	—	—

CLASSICAL UPPER SCHOOL FORM.

—	7–8.	9½–10½.	10½–11½.	11½–12½.	12½–1½.	2–3.	4–5.	5–6.	Evening, besides preparation of next Morning's Lesson.
S.	—	—	—	—	—	—	Di.	—	—
M.	Di.	—	M.	—	C.	—	—	Hist.	Exercise.
Tu.	C.	—	M.	—	C.	—	—	C.	Exercise.
W.	C.	9½–10½. C.	—	F. or G.	—	Mus. or Dr.	Hist.	M.	—
Tu	C.	—	C.	—	C.	—	—	—	Exercise.
F.	C.	—	C.	—	M.	—	—	—	Exercise.
S.	C.	—	F. or G.	—	C.	—	—	—	—

CLASSICAL MIDDLE SCHOOL FORM.

—	7–8.	9½–10½.	10½–11½.	11½–12½.	12½–1½.	4–5.	5–6.	Evening, in addition to prepared Lesson for next Morning.
S.	—	—	—	—	—	S. D.	—	—
M.	D.	—	F.	—	C.	—	H.	Exercise.
Tu.	C.	M.	10½–11½. C.	—	12½–1½. C.	—	C.	Exercise.
W.	C.	—	C.	—	Geogy.	4–4.45 M.	C.	—
Th.	7–7.30 D. 7.30–8 C.	M.	10½–11½. Drg.	—	12½–1½. C.	—	—	Exercise.
F.	C.	—	C.	—	E.	F.	C.	Exercise.
S.	C.	—	10–11½. M.	—	C.	—	—	Map.

MATHEMATICAL SCHOOL. MIDDLE SCHOOL.

—	7–8.	9½–10½.	10½–11½.	11½–12½.	12½–1½.	4–5.	5–6.
S	—	—	—	—	—	Di.	—
M.	Di.	—	M. L.	M. L.	S.	—	M
Tu.	L.	—	M. L.	—	M. L.	—	4½–6. D
W.	M. L.	Dr.	S. (write notes).	—	M.	M. L.	
Th.	M.	—	L.	—	M. L.	—	—
F.	M. L.	—	M.	—	M. L.	—	M. L.
S.	M.	M.	M. L.	—	H.	—	—

LOWER SCHOOL FORM.

—	7–8.	9½–10½.	10½–11½.	11½–12½.	12½–1½.	—	5–6.	In addition to prepared Lesson.
M.	Di.	C.	F.	F.	M.	—	C.	—
Tu.	Geog. and Repetition.	M.	C.	—	C.	—	Mod. Hist.	Exercise.
W.	C.	C.	C.	—	Anc. Hist.	Hist.	Exercise.	—
Th.	Di. and Repetition.	M.	C.	—	C.	Drawing [1¼ hr.]	—	Exercise.
F.	C.	M.	F.	F.	C.	C.	C.	—
S.	Di. and Repetition.	C.	Geog. Map.	—	C.	—	—	[Eng. Essay.]

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

(Exclusive of preparation.)	Classics.	Divinity.	Drawing.	History and English and Geography.	Mathematics.	Modern Lang.	Science.	Music.
Classical Sixth - -	15⅓	2	1*	1 or 2	4	2	1	—
Upper School - -	14	2½	1½	1½	4	2	—	—
Middle School - -	14¾	2½	1¼	3	4	2	—	1
Lower School - -	15	3	1¼	5	4	4	—	1
Mathematical Sixth -	†	2	3½	3½†	9	7	3‡	—
Upper School - -	†	2	3	3½†	9	8	3‡	—
Middle School - -	3	2	3	2	6	1	1§	1

* or Science. † or Latin. ‡ or Greek. § one of the two forms.

Private tuition is also allowed 2 hours extra in the week. In Classical Sixth, it is almost universal in Classics. In Mathematical Sixth, almost universal in Mathematics. In rest of school it is usually to make up deficiencies.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?

Classical sixth - - - 17·057

	yrs.	m.
Mathematical school, 1st set, 24 boys, average age	16	11
,, ,, 2nd ,, 26 ,, ,,	15	11
,, ,, 3rd ,, (once a week only) ,,	15	4

[Botany was taught for about two years in head form of middle school; has been discontinued.]

Question 6. Amount of knowledge required before the study of science is commenced?—None specially but what is implied by having reached the form where it is begun. In classical school this would imply four books of Euclid, algebra as far as quadratic equations. In mathematical school, about two books of Euclid, and algebra to simple equations; but before a boy gives more than one hour to it a week he has generally learnt sixth book of Euclid and done quadratics.

Question 7. Is any alternative or choice of subjects offered?—In classical school boys may draw instead of attending science; only 4 out of 29 do so. The other 25 choose science, *i.e.*, much harder work and involving great trouble in writing out notes. In mathematical school there is a choice between Greek and Science. Science is chosen in about five cases out of six. No choice allowed between different departments of science.

What departments of Science are preferred?

a. By parents?

b. By the boys?—Boys when allowed to choose between botany and German chose German in three fourths of the cases. The German was harder work, and involved much more preparation out of school.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—Only the physical sciences, chemistry, heat, electricity, and a little astronomy, are at present taught.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—In classical sixth the science lessons are 1-15th of the classical lessons in hours, but have 1-10th of the marks of the classics.

Classics	600
Mathematics	360
German	180
Drawing	60
Science	60

In mathematical school—

Mathematics	400 (lower forms (300))
Modern languages	300
Latin	150
Science	100

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—Two of the three hours are lectures, generally experimental. The third is given to the working of numerical examples or written examinations.

(*b.*) Book work?—Books used in preparation for examination. Otherwise not more than twice or three times in the term.

(*c.*) Practical work?—With about two thirds of the first division two hours a week for five or six consecutive weeks in the year. Electrical measurements the subject at present (to be extended). Four boys are taken together. In the voluntary chemistry class 10 boys in two sets. Each set works 1¼ hours in the laboratory.

Question 11. Which form of lesson is found to be most effective?—Oral teaching accompanied by experiments, at least as compared with book work.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Supplementary. Notes are exacted, written from the lectures and not from books; but in preparing for examination the use of text-books is encouraged.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Boys take notes during the lesson, and are required to bring them fairly written out in a continuous form (and not as mere memoranda) at the next lesson, or, when the lesson is weekly, next day. The note books are looked over, marked, and annotated after each lesson.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

One of the class rooms has a sink with water laid on, a large table (mercury), and cupboards of apparatus. Another has simply cupboards of apparatus. There is a laboratory with 10 places, and small ante-room, and a store-room. The cost of materials to start the laboratory was about 50*l.*, but less than this would have sufficed. The benches, furnace, cupboards, &c., fitted up in the laboratory, cost 27*l.* 18*s.* (The room existed before, and the gas had been laid on to each boy's place.)

Question 17. Number of assistants and curators, and annual cost?—None.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—A fairly complete set of electrical apparatus; for chemistry and heat little more than what is absolutely necessary. The value of the electrical apparatus in use is from 50*l.* to 60*l.* In 1872 instruments and materials in science class-rooms have cost 21*l.* 18*s.* 11*d.*

	£	s.	d.
In laboratory	17	4	4
Botanical lectures have cost	11	11	0
Botanical diagrams	4	10	0
Other diagrams, about	2	0	0

No special sum is set aside beforehand.

Question 19. Is there a workshop? and if so, how and for what particular purpose is it used?

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—Barff's Chemistry, Orme on Heat, Deschanel's Electricity (Everett), Ferguson's Electricity (the latter two by seniors chiefly).

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There is a library, open to all the school at fixed hours, fairly stocked with books on natural history and science. Any boy in the mathematical or classical sixth may propose books, which are usually bought.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—There is a society called "The Natural History Society." It meets once a fortnight. One of the masters is president. There are 13 members and 25 associates. Many of the masters are honorary members. Meetings open to school on introduction of members and associates. Communications are made, objects exhibited, papers read by masters or boys indiscriminately. Two reports have been published at intervals of about 18 months, and accounts of meetings appear in the School Magazine. The number of those present varies from 40 to 80.

[Boys have read papers on Mosses, Hawks, Photography, Fortification, Electricity, Snakes, Manufacture of Alum, Natural History of Man. Masters (very much more frequent than boys) lately, on Coal Mines, Spiders, Recent Discoveries in Sea Bottom, Entomology, Botany, How a Spider spins its Web, A Walk to Finchampstead, The Eye, The Dolomite Formations in England and the Tyrol, Modern Artillery, Galls.]

Tests of Progress.

Question 23. How often is the work tested?

(1.) Note books of each lesson are looked over.

(2.) There is an examination every third or fourth week.

(3.) There is an examination at the end of each term.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—All three.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Twice in the year by the teacher of a different class in the school, and once by an independent examiner.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—For teaching electricity and heat University men (especially now that more subjects are introduced into the tripos), who have taken good mathematical degrees and have given attention to the practice of teaching in general. For chemistry it is desirable for men who have worked at the subject at school and at the University still to acquire manipulation in a laboratory, with a special view to exhibiting their experiments dexterously.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of science teaching in the school? such as—

(*a*) Success, professional or otherwise, of individual scholars.

(*b*) Influence upon the general studies and intellectual life of the school.

Several boys have done very creditably in military and other examinations. No one has been very distinguished. The work has developed quickly of late. The chemistry teaching is very limited. The good effect on the school is undeniable, but for individual distinction we must look onward for some little time.

I introduced it into the classical sixth solely with the view of increasing the boys' interest in life (there is not enough to produce results in external examinations), and of improving their literary work by widening their interests. I think it succeeds in both respects.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—Annual exhibition of 20*l.* a year for two years, tenable at school, at Woolwich, or at University. "Science" counts towards this. Governor's prize annually for examination in a portion of a text-book (prepared without assistance), and for practical work. [Last subject: Last five chapters of Tyndall's Heat, and to find in solution six specified metals.] Prizes twice a year for term work and examination in science to the head boys in this subject in the classical and mathematical schools. Two governor's prizes for botany, viz., (1) for collecting 40 plants *only* of at least 10 different orders, to be carefully dried, with descriptive schedule of each; (2) for preparing fixed portion of text-book and describing on schedule plants presented to them.

Question 31. What improvements do you think could be effected in the teaching of science in your own school?—What we immediately want is (1) a larger laboratory, with (2) more hours of attendance from the teacher of chemistry, and (3) a laboratory assistant. [A minor necessity is that in the mathematical school we want one more grade and one more class room. Each master teaching science loses time unless he has a separate class room, but he can perfectly well use such class room for different subjects.]

Question 32. What are the principal obstacles to the teaching of science in your own school?—See 31.

Question 33. How could the Universities best assist science teaching in schools?—The foundation of new scholarships and fellowships, as in former times, to encourage new studies, and meet the increasing number of persons who, to the great benefit of the country, seek higher education, would more than anything promote the devotion of years and of lives to scientific investigation, as distinct from commercial and semi-commercial aims. But the diversion of existing foundations of that nature from literary studies would at once injuriously affect all schools as well as the Universities themselves, and not ultimately promote the best interests of science.

Question 34. Can you suggest any way in which Government could assist science teaching in schools, as, for example, by inspection?—It is important that all the subjects of a school education should be pressed forward with an even hand, and the relative values affixed to them should not be destroyed, though from time to time they may be carefully remodelled. The inspection of any one single branch of work would destroy undesignedly, but steadily, the balance of studies. The examining power (whatever it is, Government or University) should be comprehensive, and provide for the inspection of all subjects.

Question 35. Have you any other information to give or suggestion to make likely to be helpful to the Commissioners?—Dispensing with the *book* as much as possible saves time to the learner and gains for him impressiveness and clearness. As in mathematics familiarity with constructions should precede the learning of propositions, so in science the sight at least of experiments should anticipate the theory. Boys who go through a course of chemical lectures before laboratory work are less patient in experiments because they are aware of the result to come. It follows from this that apparatus need not be extraordinarily complete or costly, but may grow by degrees. Public examinations which boys enter from school need at least as careful attention, and central regulation or advice, as the schools do.

E. W. BENSON,
Head Master.

Oct. 25, 1872.

10. CHELTENHAM COLLEGE.

General Arrangements.

Question 1. How is the school classified?—There are three departments, viz., the classical, the military and civil, the junior (boys under 13 years of age).

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—In the classical department science is taught as an alternative with German to boys in the four highest of the nine classes; and to select boys in first class a second scientific subject is also taught as alternative with French. Boys in the Latin class (no Greek) also are taught science. Total number learning science, 86.

In the military and civil department it is a necessary part of the school course for all boys in the four highest of the nine classes. Total number learning science, 128.

Question 3. Copy of time table?—Time tables of science masters and of every division of the four highest classes:—

CLASSICAL DEPARTMENT. Class i. A. B.—TIME TABLE.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	Greek Testament and Thursday's copy returned.	Horace, with fresh copy.	Œdipus Rex: with 40 lines Repetition, and Saturday's copy returned.	Horace, with fresh copy.	Œdipus Rex: with 40 lines Repetition, and Tuesday's copy returned.	Œdipus Rex, fresh copy.
9·50—10·40		—		—		—
10·40—11·30	Unseen, fresh	Cicero	Composition without books; or English. (Alternatives)	Cicero	Unseen, returned.	
11·30—12·15	English; or Roman History. (Alternatives.)	German, *Botany*, Extra Classics, or *Chemistry*. (Alternatives.)		German, *Botany*, Extra Classics, *Chemistry*. (Alternatives.)	Composition without books, returned.	German, *Botany*, Extra Classics, *Chemistry*. (Alternatives.)
2·30—3·20	French, *Electricity*, Extra Classics, Extra Mathematics. (Alternatives.)	-	History	-	French, *Electricity*, Extra Classics, Extra Mathematics. (Alternatives.)	—
3·20—4·10	Mathematics or Extra Classics. (Alternatives.)	-	Mathematics or Extra Classics. (Alternatives.)	-	Mathematics or Extra Classics. (Alternatives.)	—
4·10—5		—		—		
5—6	English	—	—	—	—	—

CLASS i. C.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	Scripture and Greek (Arnold) Composition.	Sophocles	Horace and Repetition.	Sophocles	Horace and Repetition.	Sophocles.
9·50—10·15		—		—		—
10·15—11·30	-	Cicero	-	Cicero	-	Cicero.
11·30—12·15	-	German or Science.	-	German or Science.	-	German or Science.
2·30—3·30	French or Science	-	History	-	French or Science	—
3·30—5	Mathematics	-	Mathematics	-	Mathematics.	—

CLASS 2 A.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	Mathematics	Mathematics	Geography, Natural Science, or German.	History	Mathematics	Shakespeare.
9·50—10·40	Mathematics	- - -		- - -	- -	Natural Science (part of class).
10·40—11·30	Divinity	Livy (10·45—11·45.)		Demosthenes (10·45—11·45.)	Virgil	Livy (10·45—11·45.)
11·30—12·15	- - -	Grammar	- - -	- - -	German (part of class).	Go over corrected composition, L. V.
2·30—3·30	Demosthenes	- - -	- - -	- - -	Repetition (2·30—2·45.)	—
3·30—4·30	French	- - -	French	- - -	(Latin Prose 3—4.)	—
4·30—5	Go over corrected composition, L. P.	- - -	Go over corrected composition, G. I. or G. P.	—	—	—

CLASS ii. B.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	*Mathematics	*Mathematics	—	—	*Mathematics	—
9·50—10·40		—	—	—	—	
10·40—11.30	Divinity	Livy and Grammar.	*Science or German.	Virgil and unseen translations examined.	*Science	Virgil and History.
11·30—12·15	- - -				*German	
2·30—3·20	Demosthenes	- - -	Livy	- - -	Demosthenes	—
3·20—4·10	*French	- - -	*French	—	—	—
4·10—5	English Lesson	- - -	Fair copies of composition.	- - -	Geography	—

* Lessons by extra masters.

CLASSES iii. and iv.

—		MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	iii.	- - -	French	German or Natural Science.	Aristophanes	French	German or Natural Science.
	iv.	Cicero	French	Homer	- - -	French	Cicero.
9·50—10·40	iii.	Divinity	Mathematics	Aristophanes	Mathematics	Mathematics	Cicero.
	iv.	Divinity	Homer	- - -	Homer	Homer	—
10·40—11·30	iii.	Cicero	Mathematics	English Literature.	Mathematics	Aristophanes	—
	iv.	German or Natural Science.	Greek Grammar	English Literature.	Greek Grammar	Mathematics	German or Natural Science.
11·30—12·15	iii.	- - -	Aristophanes	History	Geography	- - -	History.
	iv.	Mathematics	- - -	History	Geography	Mathematics	History.
2·30—3·20	iii.	Unseen Latin or composition.	—	—	—	—	—
	iv.	- - -	- - -	Mathematics	- - -	Ovid	—
3·20—4·10	iii.	- - -	- - -	Virgil	- - -	Virgil	—
	iv.	Ovid	—	—	—	—	—
4·10—5	iii.	Cicero	- - -	- -	- - -	Greek, unseen, or Composition.	—
	iv.	- - -	- - -	Cicero	- - -	Latin, unseen	—

Repetition three times a week in both classes.

TIME TABLE of NATURAL SCIENCE CLASSES in the CLASSICAL DEPARTMENT.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	- - -	- - -	- - -	Latin, Chemistry	—	—
9·50—10·40	- - -	- - -	(ii.) Chemistry	- - -	—	(ii. A.) Chemistry.
10·40—11·30	(iv.) Chemistry	- - -		- - -	(ii. B.) Chemistry	(iv.) Chemistry.
11·30—12·15	- - -	(i.) Chemistry	- - -	(i.) Chemistry	- - -	(i.) Chemistry.
2·30—3·20	(i.) Electricity	*Practical Work, Chemistry. Two hours.	Latin, Chemistry	*Practical Work, Chemistry. Two hours.	(i.) Electricity	*Practical Work, Chemistry. Three hours.
3·20—4·10	- - -		- - -		- - -	
4·10—5	- - -		- - -		- -	

* Optional and gratuitous on the part of the master, Mr. Lewis, of Oriel.

CLASSICAL DEPARTMENT.—NATURAL HISTORY TIME TABLE.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—9·50	- - -	- - -	Class III. Botany	- - -	- - -	Class III. Botany.
9·50—10·40	—	—	—	—	—	—
10·40—11·30	—	—	—	—	—	—
11·30—12·15	- - -	Class I. Botany	- - -	Class I. Botany	- - -	Class I. Botany.
2·30—3·20	—	—	—	—	—	—
3·20—4·10	—	—	—	—	—	—
4·10—5	—	—	—	—	—	—

Class i A.—MILITARY AND CIVIL DEPARTMENT.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Mathematics	Mathematics	Mathematics	English or *Science*	Mathematics	Mathematics.
10.15—11·15	Mathematics	Mathematics	Mathematics	Mathematics	Geometrical Drawing.	Latin, or German, or *Science.*
11·15—12·15	English or *Science*	French	French	Divinity	English or *Science*	Free Hand Drawing.
2·30—3·20	French	- - -	Mathematics	- - -	Latin, or German, or *Science.*	—
3·20—4·10	Mathematics	- - -	Mathematics or Latin.	- - -	Latin, or German, or *Science.*	
4.10—5	Latin or Free Hand Drawing.	- - -	Geometrical Drawing or Latin.	- - -	Descriptive Geometry.	—

Class i B.—MILITARY DEPARTMENT.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Mathematics	English	Mathematics	Mathematics	Euclid	Mathematics.
10·15—11·15	Mathematics	Mathematics	French	Mathematics	Mathematics	Drawing.
11·15—12·15	Geometrical Drawing.	English	German	Science	Mathematics	Mathematics.
2·30—3·20	German	- - -	Drawing	- - -	French	—
3·20—4·10	Scripture History	- - -	Geometrical Drawing.	- - -	Mathematics	—
4·10—5	French	- - -	Science	- - -	English Literature.	—

Class i C.—MILITARY DEPARTMENT.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Drawing	Mathematics	German	Drawing	Euclid	French.
10·15—11·15	English	Geometrical Drawing.	English History, &c.	Science	German	Mathematics.
11·15—12·15	Mathematics	Science	Mathematics	Mathematics	Geometrical Drawing.	English.
2·30—3·20	English Language		Mathematics		Mathematics	—
3·20—4·10	Scripture History		Mathematics		French	—
4·10—5	Mathematics		French		Mathematics	—

Class ii A.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Divinity	Mathematics	Euclid	Mathematics	Plan Drawing	Mathematics.
10·15—11·15	Drawing	English	French	Mathematics	Natural Science	English.
11·15—12·15	Euclid	German	Natural Science	German	Euclid	—
2·30—3·20	History		Mathematics		French	—
3·20—4·10	Plan Drawing				Geography	—
4·10—5	French		History		Drawing	—

Class 2 B.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Divinity		Plan Drawing	Drawing	Mathematics	French.
10·15—11·15	Euclid	English	Natural Science	Plan Drawing	Mathematics	English.
11·15—12·15		Mathematics	Euclid	Euclid		Mathematics.
2·30—3·20	Natural Science		German		Drawing	—
3·20—4·10	German		Geography		French	—
4·10—5	History		French		History	—

—		MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	iii. A.	Algebra		Euclid	History	History	Geography.
	iv. A.	Plan Drawing	History	Science	French		Drawing.
10·15—11·15	iii. A.		Euclid	Euclid	German	Algebra	—
	iv. A.	Arithmetic	Science	Plan Drawing	Arithmetic	Drawing	Geography.
11·15—12·15	iii. A.	German	Plan Drawing	Physical Geography.	French	French	—
	iv. A.	Mathematics	Euclid	Euclid	Algebra	German	Euclid.
2·30—3·20	iii. A.	Divinity		Science		Algebra	—
	iv. A.	Divinity		Arithmetic			—
3·20—4·10	iii. A.	Algebra		Drawing		Plan Drawing	—
	iv. A.	French		History		Algebra	—
4·10—5	iii. A.	Drawing		Arithmetic		Science	—
	iv. A.	German				Algebra	

Class 3 B.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15		Euclid	French	German	Algebra	—
10·15—11·15	Science	History		French		Euclid.
11·15—12·15	German		Arithmetic	Algebra	Algebra	—
2·30—3·20	Scripture History		Physical Geography.		Algebra	—
3·20—4·10	Algebra		Science		Geography	—
4·10—5			Euclid	—	—	—

Class 4 B.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15	Arithmetic	Science	Algebra	Algebra	French	Euclid.
10·15—11·15	Algebra	French	Euclid	Algebra	Arithmetic	
11.15—12·15	Euclid	Algebra	Arithmetic		Science	Algebra.
2·30—3·20			History		Geography	—
3·20—4·10			Algebra	—	—	—
4·10—5	Scripture History		German	—	—	—

TIME TABLE of the SCIENCE MASTER in MILITARY and CIVIL DEPARTMENT.

SCIENCE.

—	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
9—10·15		4 B. Class	4 A. Class	1 A. Class	—	—
10·15—11·15	3 B. Class	4 A. Class	2 B. Class	1 C. Class	2 A. Class	1 A. Class.
11·15—12·15	1 A. Class	1 C. Class	2 A. Class	1 B. Class	4 B. Class	—
2·30—3·20	2 B. Class		3 A. Class		1 A. Class	—
3·20—4·10			3 B. Class		1 A. Class	
4·10—5			1 B. Class		3 A. Class	—

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately).—*See* Time tables, enclosed, in answer to Q. III.

Six boys in classical department are taken, two at a time, three evenings weekly, two hours each time, 4.30–6.30, purely voluntary gift of his time by the science master, for practical work. In all departments of the College much time is given out of school hours to preparation of work of every kind. All boys are in school 27 hours a week. Hard-working boys in the upper classes would give 25 to 30 hours a week to preparation out of school. The idlest boarder in the lowest class must give 14 hours a week, in the evenings, to preparation under supervision in large room. Elder boys work in their own study without supervision.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the natural science classes?

Classical Department:—

		Boys.	Average age.
Class I.	Electricity	6	18 years 1 months.
	Chemistry	6	17 „ 0 „
	Botany	20	17 „ 8 „
„ II.	Chemistry	18	16 „ 9 „
„ III.	Botany	8	16 „ 6 „
„ IV.	Chemistry	12	17 „ 6 „
Latin class.	Chemistry	16	16 „ 2 „

Military Department:—

	Boys.	Average age.
Class I.	39	17 years 0 months.
„ II.	30	16 „ 2 „
„ III.	29	16 „ 3 „
„ IV.	29	16 „ 1 „

Question 6. Amount of knowledge required before the study of science is commenced?—In classical department such an amount of knowledge is required as places the boy in some one of the four highest out of the nine classes, or in one of the two higher of the three divisions of the Latin class.

In the military and civil department a certain amount of knowledge of mathematics, viz., Euclid, four books; algebra, to binomial theorem; arithmetic, all the principal rules. A boy cannot well have got to Class IV. without this knowledge.

Question 7. Is any alternative or choice of subjects offered?—None, except such as appears in the time tables, *see* under Q. 3. There is a settled order of subjects, especially in the military department, to meet the average capacity of boys in the classes taught.

What departments of science is preferred?

a. By parents?

b. By the boys?

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—*See* time tables, under Q. 3. The subjects chosen are practically determined by the examinations for which our boys are preparing, *e.g.*, classical department for scholarships at the Universities and for Indian Civil Service.

Military Department for Woolwich and Cooper's Hill.

The military boys are first taught the chief facts and principles of physical science. Chemistry is not taught till a boy reaches the first class, and then it is studied theoretically and practically. In this class chemistry and heat are alternative subjects with magnetism and electricity, or with geology and physical geography.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—In classical department 7 per cent. in marks of half year, in examination 12½ per cent.: in military department not quite 20 per cent.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—Speaking generally, especially of Military department,—

(*a.*) ½
(*b.*) ¼ } would be correct.
(*c.*) ¼

(*b.*) Book work?—But this varies with subject, and with master, *e.g.*, in botany, practical work is confined almost entirely to summer months, when at least half of every lesson is (*c.*) practical. In winter there would be occasional microscopic demonstration.

(*c.*) Practical work?—The science master in the classical department makes lessons in electricity, principally (*a.*) oral and demonstrative, with (*c.*) practical work for voluntary pupils on half-holiday evenings, and in chemistery makes two lessons out of three (*a.*) oral and demonstrative, the third lesson catechetical.

Question 11. Which form of lesson is found to be most effective?—Speaking generally, the combination of (*a.*), (*b.*), (*c.*) of Question 10 is more effective than either (*a.*) or (*b.*) or (*c.*) alone; but much depends on the nature of the subject and the character or genius of the teachers; and when diverse forms of teaching are used as supplementary to each other, it is impossible to contrast their efficiency.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Masters and methods differ; subjects differ also. One master would reply, chiefly preparatory; both for first (or demonstrative) lesson, and also for last (or catechetical) lesson. Another master would say, simply preparatory, except so far as useful for revision of work before examination. The head master of the military department, a man of great experience and great wisdom in teaching, who himself taught science for many years before any special master for science was appointed, says: "The subject matter of each lesson should generally be explained in advance; it is then learnt from text-books during preparation hours, and tested at the next lesson time. If any points are not clearly understood, they are again explained, and notes made by the boys."

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Masters differ in their method slightly:—

A. "Both during and after their lesson, to a considerable extent." (*a.*) and (*b.*)

B. "Chiefly during lesson, as supplementary to text-books." (*a.*) only.

C. "Short notes are taken during lesson (*a.*) Fuller notes and explanations are made in note-books after the lesson." (*b.*)

Where notes are taken after the lesson (*b.*), it is that they may subsequently be produced to the master.

Question 14. How far are boys required to prepare their own apparatus or experiment, or to collect specimens during the intervals between lessons?—Experiments are made in the presence of boys during lessons by the master; and are also made by the boys in the presence of the master at the practical voluntary work.

Apparatus is not prepared by the boys except for botany, and for botany it is both for lessons and for holiday task.

In the military and civil department, excellent laboratory experiments are made by the boys in the presence and under the superintendence of the master, but usually by the master himself.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

There is an excellent laboratory and lecture-room for the military department; an excellent lecture-room for the classical department, which will gradually acquire many of the appliances of a laboratory. There is a museum, partly scientific in contents and arrangement, and there is a botanical garden of half an acre. The museum is barely three years old, the botanical garden just 12 months.

Question 17. Number of assistants and curators, and annual cost?—The museum is in charge of a resident member of council, without salary. A master, lately deceased, was curator, and a yearly grant of 50*l.* had been voted him by the council.

The botanical garden is in charge of the natural history master in the classical department, without salary.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—The necessary apparatus and diagrams are fully provided for the military department, and are being gradually provided for the classical department, into which science was introduced only three years ago. No yearly sum is allowed for new instruments or the replacement of materials, but grants of money are made by the council when asked for.

Question 19. Is there a workshop? and if so, how, and for what particular purpose is it used?—There is no workshop.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

Classical department:—

Roscoe's Elementary Chemistry.—Juniors.
Harcourt and Madan's Practical Chemistry.—Seniors.
Deschanel's Electricity.—Juniors.
Ferguson's Electricity.—Seniors.
Balfour-Stewart's Elementary Physics.—Juniors.
Balfour's Elements of Botany.—Juniors.
Balfour's Manual of Botany.—Seniors.

Military department:—

Balfour-Stewart's Elementary Physics.—Juniors.
Ganot's Physics (Atkinson).—Seniors.
Roscoe's Lessons in Elementary Chemistry.—Juniors.
Fresenius' Qualitative Analysis; Liveing's Tables.—Seniors.
Jukes' School Manual of Geology.—Juniors.
Lyell's Elements and Principles.—Seniors.

Question 21. To what books of reference other than ordinary school books, have the scholars access?—There are a few books of reference in the museum and college library, perhaps, 120 volumes; but the collection, though growing, is at present inadequate.

There are a few scientific volumes also in the house library of most or all of the boarding houses.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—There is a natural history society.

Ten masters (of whom three are working members) and 40 boys. The secretary is a boy.

The meetings are weekly or fortnightly during the winter six months; and in summer there are fortnightly excursions.

Subscription annual, 3*s.* with entrance fee, 2*s.* 6*d.* Influence is good decidedly; but does not act on a large number.

Tests of Progress.

Question 23. How often is the work tested?—Once a month, examination by master; once a year, examination by examiners appointed by the council of the college.

Question 24. In what way? *e.g.* by examination of note-books, or by oral or written questions?—Orally, in part; by written questions mainly, as regards the examiners appointed by the council.

In the same way, and also by examination of note-books by our own masters.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—By both. *See* 24.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—Great difficulty in securing downright good men:—

Ours is not a rich school, and we cannot compete in salaries with Eton, Rugby, Harrow, and Winchester.

The demand in schools for teachers of physics, chemistry, &c., has been very great for the last few years. Possibly there may be a lull in the demand when all the large schools are fully supplied; but there is no lull yet.

3. In appointing two out of our three teachers of science it has been necessary to secure first-rate mathematical teachers as well as first-rate teachers of science; but apart from this necessity in two out of three appointments, I believe that a scientific and thorough knowledge of mathematics is the

best basis if not the *sine quâ non* of a scientific and thorough teaching of physics and the natural sciences.

4. The Universities offer now-a-days so attractive a home for men of science, whether married or unmarried, combining the advantages of ample leisure, fair emolument, splendid collections from museums and libraries for study and observation, that even large public schools, in pleasant positions, find it hard to attract first-rate teachers of science, except the man himself has a genuine love for boys.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—The best men are to be obtained at the Universities, or perhaps University graduates with some subsequent experience elsewhere. Taking our present staff of three teachers of science in the order of their joining our staff:—

(A.) Was seventh wrangler a few years ago, and after taking his degree attended several courses of the Cambridge Professor of Botany; attended chemical lectures, and practical work in the chemical laboratory of St. John's College, Cambridge.

(B.) Under Professor Maine: first class in mathematics in moderations, and also in the final schools, first class in Natural Science, senior Mathematical Scholar in the University of Oxford, Fellow of Oriel. He has worked in the University chemical laboratories under Professors Brodie and Clifton, in the Christ Church laboratory, and subsequently in the British Museum under Professor Maskelyne.

(C.) Scholar of Sidney Sussex College, Cambridge; stood 25th in the list of successful candidates for the Indian Civil Service, scoring the highest mark ever scored in Natural Science (927 out of 1,000 maximum); was elected to an exhibition at the Royal School of Mines; was placed second in 1st class of the Natural Science Tripos at Cambridge; and since B.A. degree, has lectured in various branches of science in London.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—Success in the University examinations, successful experience in imparting his own knowledge, consensus of men of science, and of judgment that the man has the knowledge needful, the power of imparting it, and the gift of inspiring others, and the personal qualities of the man himself as seen in personal interview, after careful investigation of testimonials and confidential communication with trusted friends.

Question 29. Can you state any results of science teaching in the school? such as—

(*a*.) Success, professional or otherwise of individual scholars?—Distinctions in the competitive examinations for commissions in the Royal Engineers, and at the Civil Engineering College at Cooper's Hill, have shown again and again the practical results of science teaching in the military department. As regards the classical department, science is of recent introduction (August 1869); but R. Obbard went in straight from 1 A. classical to the Indian Civil Service examination 1871, scored 476 in natural science out of 1,000 maximum, after only nine months' work, and stood 16th in the successful list.

(*b*.) Influence upon the general studies and intellectual life of the school?

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—There are prizes after the Christmas examination in both departments; there have been special prizes for herbaria of boys' own collection, and for excellence in physical geography; and the "Old Cheltonian Society" gives a special prize for proficiency in physical science.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—Ampler apparatus in some respects.

No other improvement seems possible, except by giving "more time:" but that could only be given at the cost of other subjects.

More showy results might of course be produced by selecting three or four boys, turning them away from other work, and concentrating all their other time on science.

The selected boys would generally get a scholarship, but their education would be one-sided, and the school organisation would suffer.

Question 32. What are the principal obstacles to the teaching of science in your own school?—The competing claims of other subjects.

Question 33. How could the Universities best assist science teaching in schools?

1. By offering more scholarships for knowledge in this subject.

2. By offering more fellowships for the same subject, as the absence of definite ulterior prospects deters many students of science from leaving the more remunerative lines of study.

Question 34. Can you suggest any way in which Government could assist science teaching in schools, as, for example, by inspection?

1. Not by inspection, for which work the Universities are fitter, being less bureaucratic, more elastic, more truly educational.

2. In examination for Civil Service appointments, at home and abroad, science might be always an ingredient. But as a test of youthful intellect, science seems to me more capable of rapid cram than mathematics or linguistic subjects; and to that extent less trustworthy as a mere test.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

T. W. JEX-BLAKE,
Head Master.
Oct. 26th, 1872.

---

11. CHARTERHOUSE SCHOOL.

General Arrangements.

Question 1. How is the school classified?—The school is divided into 11 forms, viz.:—

6th	Upper school.
Upper 5th	
Under 5th	
Upper 4th	Under school.
Under 4th	
Upper Shell	
Under Shell	
Upper 3rd	
Under 3rd	
2nd	
1st	

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Science forms a part of the obligatory school course from the 6th form to the Under 3rd inclusive.

Question 3. Copy of time table?

Monday	10.45	–	11.45	a.m	Upper 3rd.
„	11.45	–	12.30	„	Upper Shell.
„	3	–	4	„	Sixth Form.
Tuesday	3	–	4	p.m.	Upper and Under Fifth.
„	4	–	5	„	Upper Fourth.
Wednesday	9.30	–	10.30	a.m.	Lower Shell.
„	10.45	–	11.45	„	Lower Fourth.
„	11.45	–	12.30	„	Lower Third.
Thursday	as on Monday.				
Friday	as on Tuesday.				
Saturday	as on Wednesday.				

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilised for preparation or practical work, this should be shown separately.)—One subject only is taught in any given quarter; therefore, the two hours of each week are given exclusively to that one subject.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?

6th Form	12	Upper school	17
Upper 5th „	12		16
Under 5th „	20		16
Upper 4th „	19		14
Under 4th „	15		14
Upper Shell	14		13
Under Shell	15		13
Upper 3rd	18		12
Under 3rd	21		12

Question 6. Amount of knowledge required before the study of science is commenced?—For the branches of Natural Science which are for the most part descriptive (Botany, Geology, Physiology, &c.) a knowledge of mathematics is not required; but there is much difficulty in teaching these, owing to the multiplicity of hard names, which the memory cannot retain easily, if the mind succeeds in grasping them. For the branches of Natural Science which are grouped under "Natural Philosophy," viz., Chemistry, Electricity, Heat, Optics, Acoustics, Hydrostatics, &c., a knowledge of Arithmetic, including vulgar and decimal fractions, and of Algebra, including simple equations, and of elementary Geometry, is necessary. Some knowledge of Latin and Greek is also desirable for the explanation of terms. It is obvious that the boys in the Third Form are but scantily provided with such requisites.

Question 7. Is any alternative or choice of subjects offered?—No, not at present. Some communication has been held with the Universities, who have undertaken to supply the schools with a curriculum of Natural Science study, elementary and advanced. It is hoped that we shall thus be provided with an authoritative recommendation for our guidance. At Cambridge Dr. Humphry, Professor Liveing, and the Rev. Coutts Trotter have the matter in hand.

What departments of science are preferred?—(*a.*) By the parents. (*b.*) By the boys.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—Our experience is not sufficient to justify an answer to this and the preceding questions (*a*) and (*b*) of 7. As yet only Botany and Chemistry have been attempted.

Botany was taught in the summer quarter. It was not a popular subject.

Theoretical Chemistry is the subject for this quarter. It is popular with most of the boys. Practical chemistry must wait for the completion of the laboratory.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—The amount of acquirement would not at present justify us in attaching any weight to scientific attainments for determining the position in the school; but as we make advance this will be remedied.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—Each form has two lessons a week, each lesson being of one hour's duration.

(*b.*) Book work?—For the senior boys. Two lessons in succession are devoted to oral teaching and demonstration. The rest of the time is occupied in answering questions, oral and manuscript. For the junior boys. One hour of oral teaching and demonstration. Half an hour of book work. Half an hour of questions, oral and manuscript.

(*c.*) Practical work?

Question 12. How are text books used? *e.g.* Is book work supplementary or preparatory to the oral lesson?—Text books are used as supplementary to the oral lessons.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Short notes may be taken during the lesson. At the end of the lesson, time is allowed for enlargement. The notes are then looked over and corrected by the master.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—No facilities as yet for practical work.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?—The natural science master finds that the plan above given is effective; but he wishes for the addition of opportunities of practical work.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

As yet only a lecture room, with a limited chemical apparatus.

Question 20. What text-books are in use, distinguishing between those for the junior and senior classes?—Senior and junior, Oliver's First Lessons in Elementary Botany. Senior, Roscoe's Chemistry; junior, Barff's Introduction.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There will be a good supply in the general library.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—No.

Tests of Progress.

Question 23. How often is the work tested?—Frequently.

Question 24. In what way? *e.g.*, by examination of note books, or by oral or written questions?—By revision of note books, and by oral and written questions.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—By the Natural Science master.

It is contemplated that the school shall be examined by a duly qualified person from the outside.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—I have found none as yet. I know that this subject (*i.e.* the provision of qualified masters) is receiving attention at Cambridge.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—The Natural Science master now at Charterhouse came from the London University, and was trained under Dr. Williamson.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—The value of evidence in such a case depends on the character of the person by whom it is tendered. But I presume that no one would appoint a master merely on testimonials, without holding some communication, by speech or letter, with the writers of such documents.

Question 30. Are any special rewards or encouragements (*e.g.*, exhibitions, scholarships, or prizes) open to successful students of science in the school?—An exhibition is to be given annually for proficiency in Natural Science. It will be of the value of 80*l.* for four years, and may be held at an University or anywhere else, provided that the holder satisfies the governing body that he is engaged in preparation for some career in life which meets their approval.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—There is room for much improvement, as will be gathered from previous answers. Attempts are being made to promote advancement.

Question 32. What are the principal obstacles to the teaching of science in your own school?—I know of none but those that have been already specified.

Question 33. How could the Universities best assist science teaching in schools?—(1.) By offering scholarships for competition.

(2.) By training qualified teachers.

(3.) By providing examiners.

Question 34. Can you suggest any way in which Government could assist science teaching in schools, as, for example, by inspection?—I think that the governing body of the school, with the aid of duly qualified examiners, can do all that is required for the advancement of science teaching.

Wm. Haig-Brown,
Head-master.

November 4th, 1872.

---

12. Clifton College.

General Arrangements.

Question 1. How is the school classified?—The school consists of three divisions:—

1st. The classical side, containing 229 boys.
2nd. The modern side, containing 110 boys.
3rd. The junior school, containing 114 boys.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—(1.) Science is taught as an alternative for German in the VI. and V., that is, the four highest forms of the classical side. These forms contain 99 boys, of whom 31 are learning science.

In the remaining forms of the classical side and throughout the modern side, as also in the two highest forms of the junior school, it is taught, as a matter of course, to our boys without exception.

This part of the school comprises 294 boys.

In the three lowest forms of the junior school, consisting of 60 boys between 10 and 12 years of age, science is not taught.

(2.) In the VI. and V. forms, both classical and modern, boys who show special taste for science or who are likely to require it for professional purposes, or for some competitive examination, are also taught in special classes so arranged as to form alternatives for some other parts of the school routine.

(3.) There are also voluntary classes doing practical work in the Chemical Laboratory, Botany, Geology, Physical Geography, Zoology, and Physiology.

Question 3. Copy of time table?—Time table as follows:—

SCHEME OF WORK.

		Classical Side.			Junior School.	Modern Side.
Days.	Hours.	Sixth and Fifth Forms.	Fourth Forms.	Third Forms.	Fourth Forms.	All.
Monday -	9–10	Divinity.	Divinity.	Divinity.	Divinity.	Divinity.
	10–11	Classics or *special science.*	Classics.	Classics.	English.	History.
	11.15–12.15	Do. *do.*	Classics.	Classics.	Arithmetic.	Mathematics.
	4–5	Classics.	Drawing.	*Physics.*	Classics.	*Physics.*
	5–6	Mathematics.	French.	Classics.	Classics.	Mathematics.
Tuesday -	9–10	Classics.	Classics.	Classics.	Arithmetic.	*Chemistry.*
	10–11	Do.	Do.	History.	Classics.	French.
	11.15–12.15	Do.	*Chemistry.*	Classics.	French.	German.
	4–5	Do.	Classics.	Classics.	Classics.	History.
	5–6	Do.	Classics.	Classics.	Classics.	Mathematics.
Wednesday -	9–10	Classics.	Classics.	Classics.	Classics.	Classics (Latin).
	10–11	Do. or *special science.*	Classics.	Classics.	Geography.	Mathematics.
	11.15–12.15	Do. *do.*	Classics.	French.	Arithmetic.	Drawing.
	4–5	German, or *natural science.*	Mathematics.	Mathematics.	Classics.	German.
	5–6	Mathematics.	French.	*Physical geography or botany.*	Classics.	Geography.
Thursday -	9–10	Classics.	Classics.	Classics.	Arithmetic.	*Physics.*
	10–11	Do.	Classics.	French.	Classics.	Mathematics.
	11.15–12.15	Do. or *special science.*	English and classics.	English.	History.	French.
	12.15–1.15	Do. *do.*	Mathematics.	Mathematics.	Classics.	German.
Friday -	9–10	Classics.	Classics and history.	Classics.	Classics.	French.
	10–11	Do. or *special science.*	Classics.	History.	French.	Classics (Latin).
	11.15–12.15	Do. or *ditto.*	Classics.	Drawing.	Classics.	*Chemistry.*
	4–5	History.	Mathematics.	Mathematics.	Classics.	Geography.
	5–6	Mathematics.	Classics.	Classics.	Classics.	Mathematics.
Saturday -	9–10	English.	Mathematics.	Mathematics.	Drawing.	French.
	10–11	French.	*Physics.*	Geography.	*Physics, or physiology or botany.*	Classics (Latin).
	11.15–12.15	Classics, or *special science*	Classics.	Classics.	Classics.	German.
	12.15–1.15	German, or *science.*	Classics.	Classics.	Classics.	English.
Sunday -	10–11	Divinity.	Divinity.	Divinity.	Divinity.	Divinity.

Those on the Modern Side who do special science have about the same amount of special lessons as those on the classical, in addition to the four hours given above.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately):—

(*a*) *Classical side.* VI. and V., *first* and *second* division arranged according to proficiency in science.
Do. do. upper and lower IV. do. do.
Do. do. do. do. III. do. do.
Each division, *two lectures every week.*

Modern side. *First, second,* and *third* division arranged according to proficiency in science. Each division, *four lectures every week.*

Junior school. In one division, *one lecture every week.*

Special science classes. Consisting of boys in the VI. and V. forms, *seven or eight hours of class teaching every week in addition to the lectures* mentioned above.

Voluntary classes:

(I.) Boys working in the chemical laboratory are obliged to attend not less than three hours every week; many go much more than that. The hours of laboratory work are generally taken from what in our terminology is called "out-of-school hours," designated in the question as playtime.

The remaining voluntary classes mentioned under question 2 generally meet once a week. In the case of Botany and Geology the lessons are supplemented by excursions from time to time on half-holidays. In all the various classes the boys are expected to keep note-books, and to give some time to the study out of school, either as preparation for the lesson or in the way of reading afterwards. It should also be added, that of Voluntary Botany, Geology, and Physical Geography classes, it seldom happens that more than *two* are going on during the same term, that the Zoology and Physiology classes are confined to a small number of the senior boys; and that none of these voluntary classes involve any extra payment excepting the work in the chemical laboratory.

We also possess a small physical laboratory in which a few boys do some work with the physical master, but this is not yet sufficiently organized for me to be able to report upon it more definitely.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?

		Boys.	Average age.
Classical VI. and V. -	1st division	19	16
" " -	2d "	12	16
" IV. -	1st "	24	14½
" " -	2d "	43	14½
" III. -	1st "	33	14
" " -	2d "	30	13

		Boys.	Average Age.
Modern side -	- 1st „	31	16
„ -	- 2d „	36	15½
„ -	- 3d „	43	14½
Junior school -	- one „	54	12
Chemical laboratory	- one „	54	18 to 16
Botany class (voluntary)	- average No.	12	15 to 16
Geology „ „	- „	11	15 to 16
Physical Geography	- „	10	15 to 16
Zoology -	- „	4	17
Physiology „	- „	4	17

Question 6. Amount of knowledge required before the study of science is commenced?—The average attainments of a boy of 12.

Question 7. Is any alternative or choice of subjects offered?—It has happened in a few cases that we have allowed boys to do physiology instead of physics, or, when preparing for a Government examination, to confine their attention for a little while only to those branches of science which they intend to present for examination; but our rule is to make all boys in any particular part of the school do the subject prescribed for that division.

What departments of science are preferred?

a. By parents?—I have never consulted parents on the subject of their preference as between one branch of science and another, and I should consider their opinion as a general rule quite worthless.

b. By the boys?—The preference of the boys, so far as they state any, is generally determined by some accidental circumstance. I should say that, on the whole, judging by the examination papers which pass through my hands, boys find physics somewhat easier than chemistry, so that, of the two, the duller boys would probably be found to give the preference to the former study.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—To the younger boys we teach elementary physics, physical geography, or botany. These subjects have been taken in turn. The elder boys learn chemistry and physics. So far as I have been able to arrive at any definite opinion, I consider this to be the best arrangement of subjects from a purely educational point of view, provided that it is supplemented, as with us, by an elastic system of voluntary classes to facilitate the development of individual tastes.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—Marks are assigned for each hour of scientific work just as for any other kind of work, and on the same scale, our principle being to award a fixed number of marks for every hour's work whatever the subject.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—A precise and definite answer to a question of this kind is not very easy. All the lessons consist mainly of oral teaching combined with more or less demonstration, excepting, perhaps, some of the special classes in chemistry and physics in which it often happens that the lesson is chiefly catechetical or taken up with the working out of examples and propositions.

(*b.*) Book work?—The boys are generally expected to read certain portions of the text book in use as a preparation for each lesson.

(*c.*) Practical work?—Practical work is confined, for the most part, to the laboratory classes, botanical and geological examinations, and the manipulation of flowers in some of the botanical lessons.

Question 11. Which form of lesson is found to be most effective?—I cannot describe any single form of lesson as likely to prove very effective.

In teaching boys of ordinary ability who possess but little knowledge, it is necessary in the first place to lecture a good deal and to impress important facts, principles, and methods as distinctly as possible by illustrative experiments. Without such help, owing to the great want of imagination, many boys would not discover their own tastes, and such conceptions as they might derive from their reading or catechetical lessons would be extremely confused and indistinct; besides that, good lectures greatly facilitate the progress even of those boys. On the other hand, however, it is at least equally necessary to guard against the passive attitude of the learner who is merely or chiefly a listener to lectures. Thus, a good lecturer will always take great pains to keep his class alive by means of test questions, or by insisting on well written notes, or such other method as may be most conveniently applied. A good deal of the scientific instruction which has hitherto been given in schools has failed, comparatively, as a means of educational training, simply from the fact of the teacher or lecturer having allowed the boys to be too exclusively passive and receptive.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatary to the oral lesson?—In some cases the master gives his lecture, and requires his class to take notes, and then expects them to read certain portions of bookwork bearing on the subject, on which he questions them at the beginning of his next lesson, before proceeding to his new lecture; in others, the bookwork is prepared beforehand, and the lecturer applies his test questions as he proceeds with his lecture. In this respect the master uses his own discretion, and his choice, as between the two methods, is necessarily, to some extent, dependent on the age and proficiency of his class, and on the nature of the subject.

Question. 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Every boy is required to make notes in his note book during each lecture, and he may at any time be called upon by the master to produce this book as a proof of attention. In the special classes, where the numbers are comparatively small, the lessons frequent, the boys more advanced, and the method, consequently, more catechetical, the note book is not always so much used, but paper work, in some shape or other, takes the place of notes.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—This kind of preparation is chiefly confined to Botany and Geology.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?—I consider that every branch of scientific teaching which we have tried has been fairly successful, quite as much so as could have been expected in the case of new studies. More particularly, I should speak of Chemistry and Physics as having proved a valuable addition to our school work in the middle and upper parts of the school, whilst the same may be said of Botany, Physical Geography, and Elementary Physics among the younger boys, and of Geology as taught to a voluntary class.

Our methods are, I hope, sufficiently indicated in my answers to questions 10 to 13.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for Scientific Instruction, and how is it used?—Our special provision for science is as follows:—

(1). For Chemistry:—

Lecture room to seat about 60 boys.

Laboratory adjoining, fitted up so that 14 to 16 boys can work in it simultaneously.

Instrument room and store room attached.

These rooms were built and fitted up at a cost of about 600*l.*, exclusive of chemical apparatus and material.

The average annual cost of this branch has been for lectures about 15*l.* during the last two years, for laboratory about 30*s.* each student.

(2.) For Physics:—

Lecture room to seat about 60 boys.

Small class room and store room adjoining.

Laboratory adjoining.

These rooms were built and fitted up at a cost of about 200*l.* exclusive of apparatus and material.

The average annual cost of this branch has been about 30*l.* for the last two years.

(3.) For Elementary Chemistry and Physics, *i.e.* for continuous courses of Chemistry and Physics, in which the text books used are Roscoe's Primer and Stewart's Primer, the lecturer adding a good deal to what is contained in these books as he goes along.

For this part of our teaching I have fitted up a lecture table with cupboard, laid on the gas and water, &c., in one of our ordinary class rooms large enough to seat from 50 to 60 boys at an expense of about 8*l.* to 10*l.*

The master at the outset expended also for chemicals and apparatus, such as a pneumatic trough, large retort stand, gas jars, flasks, &c., the sum of 7*l.* 5*s.*

Some things which he only requires occasionally, such as air pumps, models of pumps, &c., he has hitherto borrowed from the Physical room.

He informs me, however, that with a grant of from 3*l.* to 5*l.* a year, he can keep up and add to his stock of material and apparatus, so as to be able, in the course of about two years, to do all he requires without borrowing anything.

Our experience in connexion with this room shows that elementary instruction in science can be carried on at a much cheaper rate than is generally supposed, provided that the teacher will take the trouble to think for himself and expend a little time in preparing apparatus from simple materials.

(4.) Botanic Garden and Museum :—

For a description of these I may refer to the last report of the master who acts as curator, contained in our Scientific Society's Transactions, Part II., pp. 93–102. (Copy enclosed.)

It is not easy at this early stage to calculate exactly the current expenses of museum and garden, but they need not amount to more than 50*l*. to 60*l*. a year.

They have been furnished entirely by means of private subscriptions amongst masters, boys, and friends of the college, and donations from some public institutions.

Question 17. Number of assistants and curators, and annual cost?—The question of cost has been answered above. The Natural History master acts as curator of museum and garden. In the way of paid assistance, he has about one third of the time of a boy, and a gardener about two days every week.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—Answered above, as far as possible.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—We have a workshop, of which I enclose a ground plan. This being too small for our purpose we are about to convert it into class rooms, and build another on a larger scale, of which I also enclose a plan.

The object of the workshop may be described as being (1) to teach boys the use of all the common mechanical tools; (2) to give them some knowledge of different kinds of material, as wood, iron, &c.; (3) to teach them practical carpentering, fitting, turning, forging, &c.

The present shop contains (1) four large carpenters' benches, to accommodate 16 boys; (2) eight vices, with steel chisels and other requisites for fitting, &c.; (3) a forge, with the necessary appliances; (4) three turning lathes, with one slide rest, for the turning of both wood and iron.

About 50 boys work in it, at such hours as they can spare during out-of-school time, each boy paying a fee of 15*s*. a term, or 2*l*. 5*s*. a year, to cover the expenses of superintendence, instruction, and material.

Joining the workshop is quite a voluntary matter, and any boy can take home anything which he makes there.

The cost of the building, which is quite a plain one, and the fittings, tools, &c. was something under 250*l*.

The superintendent informs me that he estimates the cost of material used, with wear and tear of tools, at about 15*s*. per week.

It may be added that any school will find a workshop to involve very little expenditure, as the superintendent will be able at such times as he is not occupied with the boys to effect a considerable saving by attending to repairs, the making of desks, forms, &c.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

(1.) Chemistry :—
Roscoe is at present the book generally used, but we are about to replace it gradually by Miller's Text-book of Inorganic Chemistry.
Cooke's First Principles of Chemical Philosophy, for special classes.
Miller's Elements of Chemistry, for special classes.
Harcourt and Madan's Practical Chemistry, with MS. Notes, Tables, &c., supplied by the Master in the Laboratory.
Roscoe's Primer, for the youngest boys.

(2.) Physics :—
Deschanel's Natural Philosophy, in the Upper Class.
Todhunter's Mechanics, in the Upper Class.
Balfour Stewart's Physics, in the Lower Class.
Do. do. Primer, for the youngest boys.

(3.) Geology :—
Page's Small Handbook.
Jukes and Geikie.

(4.) Botany :—
Oliver's Botany.
Balfour's Outlines.

(5.) Physical Geography :—

(6.) Zoology :—
Nicholson's Manual.
Physiology :—
Kirke.
Rolleston's Forms of Animal Life.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—See the Library Catalogue, enclosed.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—We have a flourishing scientific society, consisting of about 70 members, managed by one of the members as president and a committee of boys. It has exercised a valuable influence by stimulating the taste and intellect, and giving much enjoyment to many boys who would otherwise have lived a very obscure and dull life in the school, whilst it has also been of use in helping to give something of an intellectual tinge to the ordinary intercourse and conversation of the boys. Such institutions prevent the athletic side of school life from becoming too exclusively predominant.

For a further expression of my opinion on this subject I beg to refer you to the answers I sent to the Commissioners two years ago. [See p. .]

I enclose a copy of the transactions of our society, from which it may be seen how it is worked.

Tests of Progress.

Question 23. How often is the work tested?—In addition to the usual examination at the end of each term, we test our science teaching by giving a printed paper of questions once in three weeks. Every boy who fails to obtain a certain proportion of the marks awarded to this paper is kept in the following half-holiday to go over the various questions with the master.

The note books which the boys are required to keep are examined, either at the time of their examination or at such intermediate times as the master may arrange.

These tests are of course not intended to obviate the necessity of catechetical questions with which a master begins his lecture, or which are interspersed by him in the course of his lecture.

If any lecturer once stops to ask a boy picked out at random to repeat what he has been saying during the last two or three minutes, he will soon learn the necessity of such parenthetic questioning.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—Answered above.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—At the end of the summer term, which completes our school year, the work is examined by an examiner from the University.

At the end of each of the other two terms the masters examine and report upon each other's work, it being a rule with us that where it can be avoided no one examines his own work. For the other examinations, to which I alluded above as held once in three weeks, the teacher sets and looks over the papers on his own subjects. This I consider necessary as a means of showing him where his teaching is successful and where and how it is failing. These papers with the marks and report all pass through my hands when they have been looked over by the master, before being given back to the boys.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—Undoubtedly there is as yet great difficulty in procuring masters equal in all respects to the best classical masters, and this is likely, for some time to come, to add considerably to the drawbacks in the way of sufficient science teaching in schools.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—Oxford seems, as yet, to produce more men suitable for the work in a school like ours than any other single place, but they cannot be said to be in any way trained for their work, having, in fact, to learn their business when they come to us; and the Oxford system has, at best, this very grave defect, that the men who are trained in it are apt to take away with them very extravagant notions about the apparatus necessary for teaching science in schools. They might, with advantage, be made a great deal more capable of helping themselves.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—Evidence of success in teaching, and good University degrees, as at Oxford or the London University. The testimonials of individuals I have found to be of little value, as many scientific men who write them seem to have but little idea of the requirements for success as a schoolmaster.

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars?—Besides various successes of an inferior sort, our boys have gained within the last two years four Natural Science Scholarships at Cambridge, and three at Oxford.

(*b.*) Influence upon the general studies and intellectual life of the school?—I consider that the introduction of science has not in any way interfered with the successful pursuit of the old studies, whilst many of our boys who have gained distinction in Classics or Mathematics have thus acquired a sound elementary knowledge of two or three branches of science, and many others have had all their powers stimulated by thus finding out that slowness in learning languages does not necessarily mean general stupidity. Thus, the number of boys who do nothing well, and have no intellectual interests, has been materially diminished, and the general tone of the school life has been raised in proportion.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—A fair share of all our prizes and scholarships is awarded for proficiency in Natural Science.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—This is a wide question. I hope to improve it by getting the masters to enforce their methods, by developing more fully the system of classification according to ability and proficiency, by giving more time to the study of particular periods of a boy's school life, and thus producing the acceleration of progress which comes of concentration. Thus, and in many other ways, I hope to make the teaching considerably more effective than it has been hitherto, though I am well satisfied with our results, considering all the obstacles that beset any branch of new learning.

Question 32. What are the principal obstacles to the teaching of science in your own school?—1. Want of previous training or experience on the part of the masters, each one having to a great extent to discover his method by experiment.

2. The difficulties in finding sufficient time without displacing some other study which the boys cannot afford to give up.

3. The difficulties in the way of classifying boys according cproficiency, and arranging the teaching so that the boys may be kept as active as possible, and not remain simply passive listeners to a lecture.

The difficulty in the way of a progressive arrangement of classes, at least in a large school, is that it necessitates the teaching of several classes simultaneously, in other words several scientific masters, and several rooms fitted up with the necessary apparatus.

I have succeeded so far as to be able to teach three or four sets simultaneously.

4. The prejudice against a new study which, to some extent, lingers long in the minds of both men and boys.

5. The want of good and cheap text books.

Question 33. How could the Universities best assist Science-teaching in schools?—By offering more inducements to the study of Science, by endeavouring to train men more thoroughly for school work, and teaching them how good experimental lessons may be given without the most expensive apparatus, by encouraging the writing of good text books, by instituting examinations such as those asked for by the Head-masters' Conference, and modifying their general curriculum so as to offer a fair field for these new studies.

Question 34. Can you suggest any way in which Government could assist Science-teaching in schools, as, for example, by inspection?—My own belief is that if an efficient system of University examination and inspection can be established for first-grade schools, *i.e.*, schools naturally in close connexion with the Universities, it would be preferable to a Government system, as it would be much more conducive, as things are at present, towards conducting the different branches of education, and thus curing the greatest educational defect of our time.

The Science Department under Government might, however, be of great service, by cheapening still more the supply of books, diagrams, apparatus, &c.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—The only other remark which it occurs to me, at this moment, to make is, that I believe it to be deserving of serious consideration whether the true mode of conducting the numerous studies which now claim a position in the school routine will not be found to be by concentrating the attention of the boys on a small number of subjects at one time, and arranging that the subjects shall succeed each other in some fixed order, the retention of what has once been learnt being secured as far as possible afterwards by periodical examinations.

I incline to the belief that this is the true method in regard to all the secondary subjects of a boy's education; in other words the true method of teaching Science, Modern Languages, &c., in the classical department of a school, and in the same way the true method of teaching languages in the Scientific Department.

Our present methods give great facility and readiness, but tend towards producing a certain superficiality of mind, so that I cannot help feeling that the method which I have indicated, besides lessening friction and giving the increased momentum which results from concentration, would be altogether a more wholesome educational process.

J. Percival, M.A.,
Head-Master.

November 12th, 1872.

13. Rugby School.

General Arrangements.

Question 1. How is the school classified?—For teaching purposes, the school is divided into—

(1.) The sixth form and upper school.
(2.) The middle school.
(3.) The lower school.

Each of these divisions has its own separate classification for Mathematics, Modern Languages, and Natural Science, except the lower school, in which Natural Science is not taught.

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?—In the middle school, Natural Science forms a necessary part of the course. In the sixth form and upper school, the choice is allowed between Science and German.

In the lower school, Science is not taught at all.

Question 3. Copy of time table?—*See* copy of time table in "Science work." [Given in p. .]

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)—Each subject is taught by two lessons per week of about one hour's duration each. The amount and kind of preparation required, differs in different "sets." In some, note books have to be made up from rough material taken down during the lesson. In others, definite questions have to be answered in writing, from time to time, or a certain amount of book work has to be prepared upon which oral questions are put at the commencement of the lesson, before proceeding to fresh matter; or, occasionally, a combination of the latter two methods is employed.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes?—There are 10 Natural Science Classes or "sets" in the whole school. Three in the sixth form and upper school, and seven in the middle school. The number of boys and average age in each set are given below:—

Sixth Form and Upper School.

——	No. of Boys.	Average Age.
Chemistry - - -	50	$16\frac{3}{4}$
Electricity - - -	17	$16\frac{11}{12}$
Heat and Optics - -	22	$17\frac{7}{12}$

Middle School.

1st Physics - -	20	$16\frac{11}{12}$
2nd Physics - -	51	$16\frac{1}{3}$
1st Geology - -	34	$16\frac{1}{6}$
2nd Geology - -	24	$16\frac{1}{12}$
1st Botany - -	22	$15\frac{1}{6}$
2nd - -	34	$14\frac{3}{4}$
3rd - -	30	$15\frac{5}{7}$

The staff of masters employed in teaching these 10 sets consists of a Senior Natural Science Master and four

Mathematical Masters who give a portion of their time to Natural Science.

(N.B.—The question how many masters are actually employed in teaching Natural Science in this school has evidently been overlooked, but it certainly should be stated somewhere, and, probably, as well here as anywhere.

Question 6. Amount of knowledge required before the study of Science is commenced?—As Natural Science is excluded from the lower school, a boy must at least have reached the standard of the middle school before commencing it. The only additional limitation is in the case of Physics in the middle school. At the end of the first year of a boy's work, he is allowed to choose between Geology and Physics for the second year's study. But he cannot take Physics unless he is fairly high in Mathematics. It should be stated that a certain amount of Arithmetical knowledge is absolutely required before a boy can enter the school.

Question 7. Is any alternative or choice of subjects offered?—Answer in (2) and (6) partly.

As much elasticity as possible is given to the whole system of Natural Science work in the school, so as to enable a boy to take the subject he has the greatest desire to learn, *e.g.*, in the selection of Chemistry, Heat, or Electricity, in the upper school.

What departments of Science are preferred?

a. By parents?—Chemistry and Geology are the only subjects that have been specially mentioned by parents, so far as we can learn.

b. By the boys?—On the whole, the boys have shown most inclination for Chemistry and Geology or Physical Geography, but in many cases Chemistry has proved a disappointment, in consequence of the difficulty of the numerical examples and problems, which take up much of the time of the class.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—The subjects vary according to the position of a boy in the school. In the sixth form and upper school, Chemistry and Physics are the only subjects taught, with the exception of a short course of Physiology. Under Physics is at present included Heat, Magnetism and Electricity, and Geometrical Optics treated experimentally. Our experience goes to show that Physics can be taught successfully to a larger proportion of boys than Chemistry. Indeed, it would seem that a boy requires an almost special turn of mind to grapple successfully with the ideas involved in chemical affinities and re-actions. In the middle school, and therefore with younger boys, the teaching of Physics has been found to be less satisfactory than in the upper school. The subjects that have been tried are Hydrostatics and Pneumatics, with the elements of Heat, but, although most of the boys have shown considerable interest in the *facts* and *experimental illustrations*, the power of *grasping the principles* and applying their knowledge to easy problems has been acquired comparatively by few. At present, the greater number of boys in the middle school are learning either Botany or Geology. It is hoped that in time better arrangements may be made for carrying on the instruction in the Natural History side of Science after a boy has reached the upper school.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—The proportion of the marks for different subjects, both for terms' work and examination, is given below:

Upper School.

	Terms' mark.	Exam. mark.
Classics and English	39	33
Mathematics	6	6
German or Natural Science	3	3
French	2	2

Middle School.

Classics and English	36	33
Mathematics	6	5
Natural Science	4	2
French and German	4	3

In the higher part of the school, a boy who shows ability may be allowed to drop verses, together with a certain amount of general classical work, and devote the extra time to Mathematics or Natural Science. The important fact is, that, by so doing, he does not lower his position in the school or lessen the chance of future promotion, as he receives a full equivalent of marks for actual work.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—All the lessons in Natural Science are a combination of oral teaching and demonstration.

(*b.*) Book work?—Book work is only supplementary to a lesson.

(*c.*) Practical work?—In Botany actual dissection of botanical specimens by each boy is a regular part of each lesson. In the laboratory, of course, all the work is practical.

Question 11. Which form of lesson is found to be most effective?—A combination of catechetical lecture and lesson, the boys themselves being often encouraged to ask questions upon any points not clearly understood.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Partly answered in 4. In no set does the master confine himself entirely to a text-book; it is regarded rather as affording the data upon which a lesson is founded.

Book work is always supplementary to the oral lesson.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—Only rough notes are taken at the time of the lesson. There is nothing like *dictation*. The notes are worked up more fully afterwards, and shown up about once every fortnight or three weeks.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—The boys frequently *assist* in lecture experiments, but they are not required to prepare them. In the botany sets they are encouraged to collect specimens to illustrate the lesson.

Question 15. Describe any special method of teaching some branch of Science which has been found successful in your school.—(Mr. Kitchener has drawn up the following sketch of the method of teaching Botany in the school. Mr. Wilson's lecture on teaching Botany and Geology is enclosed, in which the special plan pursued in teaching Geology is described.—[See p. .] The botanical teaching, commenced in 1864, has been conducted on a rather novel method. Flowers are at once placed in the hands of each boy, and the class are asked to make each his dissections and observations. No facts or inferences are admitted, but such as arise spontaneously from the class themselves. Terms are only supplied as the class feel the want of them, and the terms are, where possible, taught in their English form instead of in sesquipedalian words derived from Greek or Latin, or both. The study of the tissues is postponed till the time of the year when no flowers are obtainable, but it is found that, for educational purposes, the first term's course, in which the tasks of observation and description come fresh to the boys, is the most valuable in results. A description of a first lesson in this subject, as taught at Rugby, is given by Mr. Wilson in his essay "On teaching Natural Science in Schools," in the essays on a liberal education, pp. 272–276. Where flowers are not obtainable in sufficient quantities for the class, use is made of large models by M. Aurony of Paris. The scheduling method (introduced by Prof. Henslow) is much used, but the schedules are filled up in English terms, and scope is afforded for any boy to remark upon any peculiarity which especially strikes him. The description of actual specimens, with the aid of a small microscope, forms part of every examination in botany.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific Instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

The special buildings devoted to Science at Rugby comprise a laboratory, two large lecture theatres, apparatus room, and private laboratory. These are described with plan and interior view in "Nature," Vol. I., p. 485, by Rev. T. N. Hutchinson, the Senior Natural Science Master. There is also a museum containing a very fine collection of geological specimens, a large proportion of them being local, and collected by members of the school, also a good collection of minerals and numerous rock specimens. Lastly, there is an observatory (described by Mr. Seabroke). The way in which the laboratory is used is described in Mr. Hutchinson's account of "Science work at Rugby," pp. 14, 15. (Copy enclosed [given in pp. .]) The expense of erecting and fitting the suite of Natural Science Schools at Rugby was, as nearly as we can estimate, 2,000*l.*, exclusive of apparatus. The annual expenses of the laboratory and lectures are met partly by special grants of money, from time to time, for general Natural Science expenses, and partly by a payment of from 10*s.* to 15*s.* a term by each boy in the laboratory for his share of chemicals and the use of apparatus.

Question 17. Number of assistants and curators, and annual cost.—There is one assistant in the laboratory with a salary of 135*l.* per annum, and a boy to wash bottles, &c., at 3*s.* 6*d.* per week.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—The school is supplied with an exceedingly complete set of chemical, electrical, and magnetic apparatus. A moderate amount for hydrostatics, pneumatics, and heat, and something for optics. There are also numerous models and illustrations for mechanics and mechanism. The collection of diagrams, which have been prepared chiefly by the lecturers and their friends, is considerable. The following botanical diagrams are in use:—

	£	*s.*	*d.*
(1.) Henslow's botanical diagrams - -	2	9	6
(2.) Balfour's - - - -	1	10	0
(3.) Oliver's series of dried plants, illustrating the families, &c.			
(4.) Marshall's physiological diagrams -	3	15	0

For physiology there is a fine collection of prepared specimens to illustrate the typical forms of animal life. For geology, use is made of a collection of photographs of rock scenery, &c., &c. Within the last two years a complete set of standard meteorological instruments has been purchased, and regular daily observations are taken and recorded by volunteers from the school.

With regard to cost, the apparatus at present in the school must have cost between 700*l.* and 800*l.*

Question 19. Is there a workshop? and if so, how, and for what particular purpose is it used?—There is no workshop at present; but premises exist under the new gymnasium building, which it is contemplated might serve for that purpose.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—In the Upper School the text-books used are—

Roscoe's Chemistry.
Ganot's Physics, for Electricity and Magnetism.
Deschanel's Natural Philosophy, for Heat.
Airy's Geometrical Optics.

In the Middle School—

Balfour Stewart's Physics.
Jukes' School Manual of Geology.
Lockyer's Astronomy.
Oliver's Elementary Botany, and, for advanced reading,
Asa Gray's Class Book of Botany, and
Bentham's British Flora.

In the laboratory, the books used are Harcourt and Madan's Practical Chemistry and Fresenius's Qualitative Analysis.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—The Arnold Library, the different house libraries, and a small collection of books on Natural History, &c., in the room belonging to the School Natural History Society.

See 22.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—Yes. The Rugby School Natural History Society founded in 1867. It consists this term (Oct. 1872) of nine honorary members (chiefly masters of the school), 39 corresponding members (chiefly old pupils), 15 members (present scholars, who have been elected full members for work done), 62 associates (present scholars not yet promoted to full membership). The society comprises at present nearly one fifth of the school. It is worked (1) by public meetings once a fortnight, the exhibition of objects of interest, reading of papers by masters or boys, &c.; (2) by sectional meetings of boys of similar tastes, as, for instance, the Botanists, the Geologists, the Microscopists, meet for work or discussion; (3) by occasional (though necessarily rare) excursions from Rugby—this year we visited (1) Charnwood Forest, and (2) several factories at Birmingham; (4) by the use of a special room to which the society alone has access. In it are kept collections of insects, plants, &c.; dissections and skeletons arranged for study, and a library of books on Natural Science is being formed for reference. A report of the Society is published annually at Mr. Billington's, Rugby, price 1*s.* *Influence on the boys.*—The meetings show that the society is popular, as there are generally from 70 to 100 present, but great difficulty is found in getting the boys themselves to take part in the meetings, whether by reading papers or sharing in discussion; hence, greater real good is done by the smaller sectional meetings. The society is found to be very valuable in bringing to the surface any boy who has a speciality, which, in the hurry of school work, might have escaped notice. Such a boy is found out either by being introduced by his friends or by asking questions, and the President then introduces him to the other boys in the school who have kindred tastes, and brings him under the notice of the master who has charge of his subject. It is found that the boys are delighted to be of any use, and will undertake any scientific drudgery suggested to them, provided they can be told that it will do some good. Good work is done in meteorological observations, recording of floral dates sketches of geological sections, &c. (Answered by Mr. Kitchener.)

Tests of Progress.

Question 23. How often is the work tested?—Frequently during the term and always at the end.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—By examination of note books as well as oral and written questions.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—By the teachers of the different subjects, except at the end of the summer term, when the sixth form are examined in Natural Science by one of the examiners for exhibitions appointed by the University.

Teachers.

Question 26. Is there any difficulty in procuring competent Science Masters?—I have never had yet to make such an appointment, but I should not anticipate any difficulty greater than in other branches of study pursued in the school.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—I do not think I could improve upon the teachers who might be selected from Oxford and Cambridge.

They have been specially trained as students. As teachers their proficiency has been attained by practice.

As students, the University curricula with professorial guidance, and the competition for the various distinctions open to them, have given them the necessary training.

I would here observe that a mere chemist, geologist, or naturalist, however eminent in his own special department, would hardly be able to take his place among a body of masters composed of University men, without some injurious effect upon the position which science ought to occupy in the school.

I would add that it seems to me highly important that a school teacher of these subjects should be thoroughly practical in his knowledge, skilful in experimenting, and ready in devising simple and inexpensive lecture illustrations.

In preferring the two older Universities, I do so only by reason of their stronger general sympathies with public school teaching. I am aware that, if I merely wanted a highly scientific man in any branch, I might find him equally at Dublin, London, or a Scotch University.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—Tripos class lists, and other similar distinctions, such as those enumerated below, would guarantee adequate attainments. To this might be added contributions to scientific periodicals and the like.

The qualifications of teaching and maintaining discipline, which are usually more rare to find and difficult to test than those of pure science, can only be ensured as experience of the man is gradually formed.

Any difficulties arising under this head might, I think, be met by probationary appointments.

Question 29. Can you state any results of Science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.
(*b.*) Influence upon the general studies and intellectual life of the school.

(*a.*) The Natural Science Honours at the Universities since 1867 are as follow:—

1867. Natural Science Studentship, Christ Church, Oxford.
1868. Natural Science Scholarship, New College, Oxford.
1869. Burdett-Coutts' Geological Scholarship, Oxford.
„ Natural Science Scholarship, Merton College, Oxford.

1870. Natural Science Studentship Christ Church, Oxford.
,, A Whitworth Scholarship.
,, Two in First Class Natural Science School, Oxford.
,, One in First Class Natural Science Tripos, Cambridge.
1871. Natural Science Studentship, Christ Church, Oxford.
,, Burdett-Coutts' Geological Scholarship, Oxford.
Natural Science Exhibition, St. John's College, Cambridge.
,, Scholarship for Chemistry and Physics, Royal School of Mines.
,, First Class Natural Science School, Oxford.
1872. Scholarship for Chemistry and Physics, Royal School of Mines.
,, Minor Exhibition in Natural Science, Ball. College, Oxford.
,, Four in First Class Natural Science School, Oxford.
,, Natural Science Exhibition, St. John's College, Cambridge.

In addition to these several have passed the matriculation examination for the University of London, and others have gained admission to various colleges by taking up some scientific subject for examination in addition to classics, when their classical knowledge alone would have been inadequate.

(*b*) *See* p. 18 of "Science Work."

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—Numerous prizes are offered for success in various branches of science, viz.:

Physics	- - One prize of	3	guineas.
,,	- - ,,	2	,,
Chemistry	- - ,,	3	,,
Geology	- - ,,	2	,,
Astronomy	- - ,,	3	,,
Botany	- - ,,	2	,,
Practical Chemistry	,,	3	,,

Prizes are also given for the best collections of wild flowers, butterflies, and moths, and fossils, made during the summer vacation.

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own school?—

Question 32. What are the principal obstacles to the teaching of Science in your own school?

Question 33. How could the Universities best assist Science teaching in schools?—I think in no way so effectually as by maintaining a high standard of teaching and examining so as to send us the best possible teachers and examiners.

Question 34. Can you suggest any way in which Governmeet could assist Science teaching in schools, as, for example, by inspection?—I should be averse to Government inspection of the school as a whole; and the inspection of a single department seems to me likely to be more fraught with injury than benefit to the school at large considered as a place of general education.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—A scientific career, as such, opened to the aspirations of candidates, such as, I believe, exists in some countries, might probably influence for good both pupils and teachers, by giving a definite object with tangible results.

This might, perhaps, have come in under 34, as a possible function of Government.

HENRY HAYMAN,
Nov. 27th, 1872. Head Master.

---

14. UNIVERSITY COLLEGE SCHOOL.

MR. ORME'S ANSWERS.

IV. 5th Class: Chemistry and Physics, one hour and a half per week.
Upper 5th, Chemistry, one hour and a half per week;
Chemical Physics, one hour and a half per week;
Upper 6th, Chemistry, one hour and a half per week;
Practical Chemistry, one hour and a half per week.

VI. So far as I am concerned no previous knowledge is required for the lower 5th, beyond a power of taking short undictated notes. For the other classes, boys are expected to have learnt decimals.

The boys in the lower 5th do not seem to derive much benefit from the knowledge they may have acquired previously in other subjects.

X. Except in the class of practical chemistry, the subjects are explained solely by means of oral teaching and demonstration; no portion of any lesson being ever devoted to bookwork. But in "oral teaching" I include the explanation of those portions of science which the boys are expected, by the Universities, to know, but which are not capable of experimental proof in the class-rooms of a school.

Any difficulty which a boy meets with in the bookwork at home is explained to him when the lesson is over.

Practical work is done only in the practical class; it is accompanied by oral teaching, and, occasionally, there is added such further demonstration as is considered necessary to supplement the experiments made by the boys themselves.

XI. Bookwork has been tried as an experiment, but with signal failure; it would undoubtedly be the most effective form of lesson if external examiners were employed, unless, perhaps, their examinations were carried on *vivâ voce* before the science masters.

Oral teaching and demonstration are far more effective than unaided practical work: hence their fusion in the class of practical chemistry.

Practical lessons are, of course, the best form, the only true form; but much less ground is got over by this method, though the knowledge thus acquired is at once more valuable and more lasting.

XII. As books of reference, and to enable the boys to recover lost ground after absence. They are altogether supplementary to the oral lessons.

XIII. Rough notes are taken during the lesson; these are copied out into a note-book afterwards, the apparatus being sketched.

XIV. Whenever it is possible—considering the small accommodation—the boys prepare their own apparatus and experiments. They also learn how to make their own re-agents.

XV. The only answer, short of an essay, is: teach them only what they can comprehend, and, of all experimental truths, those only which are capable of experimental proof in the class-rooms of a school.

It follows, almost as a corollary, that a boy should not be expected to learn the whole of any one sub-division of a natural science.

XVI. *Laboratory*, for practical work. Work done consists of—(1) Preparation of common gases, acids, and ordinary re-agents. (2) Examination of their properties. (3) Qualitative analysis in connexion with non-metallic elements.

Lecture-room, with experimental table. Work done consists of—(1) Chemistry of non-metallic elements. (2) Heat. (3) Electricity and magnetism. (4) A very little metallic chemistry.

XVIII. Apparatus very simple at present, there not being sufficient accommodation for anything costly. We have the College to fall back upon, however, and, through the kindness of Dr. Williamsom, apparatus is often obtained from that source.

The sum allowed is not limited, to my knowledge.

Anything really required is purchased without delay or hindrance of any kind.

XX. Gill's Chemistry for Schools is used for upper 6, chemistry.

Orme's Science of Heat for upper 5, chemical physics.

But text-books are of comparatively little use unless the master takes the subject in the same order as he finds it in the book.

XXIII. About once a month.

XXIV. By written answers to questions dictated at intervals of about five minutes.

XXV. By the teachers.

XXXI. A smaller quantity should be taught, but more perfectly. It should be more general in character, and should take in more of the every-day life of a boy, so as to make him think of science despite himself.

It should be, throughout, entirely experimental, to the total exclusion of theories except the few very simple ones, which a boy can easily grasp, and these only sparingly and at long intervals. Far more stress should be laid on the practical work. Boys should be taught some scientific facts much earlier than they are at present, certainly before 13 years of age. As the matter stands now, boys are allowed to acquire unscientific habits of thought before they begin to learn science, and when they do begin, the master has not to teach them science, but to eradicate the evil effects of past neglect—to undo, not to do.

XXXII. The requirements of the Universities, especially the University of London, which prevent the adoption of the improvements mentioned in XXXI. The Universities require more than can be properly learnt by a boy of 16;

they require that knowledge to be very special in character, and not by any means to have any connexion with the daily life of the boy; he is asked about chemical substances which he may never see or hear of again for the rest of his life; they seem to lay more stress on theoretical than on experimental knowledge, judging from their questions and from the candidates who pass; indeed, the boys will often leave the practical class for the purpose of preparing for the examination. Lastly, they require an inordinate amount of knowledge in other than scientific subjects, so that a boy cannot well begin science before 14 years of age.

XXXIII. By altogether revising the regulations for their examinations.

XXXIV. Inspection of the ordinary kind, especially Government inspection, I should think would encourage that sort of teaching which temporarily shows the best results, viz., bookwork. The masters would teach to satisfy the inspectors, not so as to benefit the boys or advance the school in the estimation of the public.

Chemical Theatre and Laboratory. Fittings.[*]

It is necessary to divide the following account into two parts:—

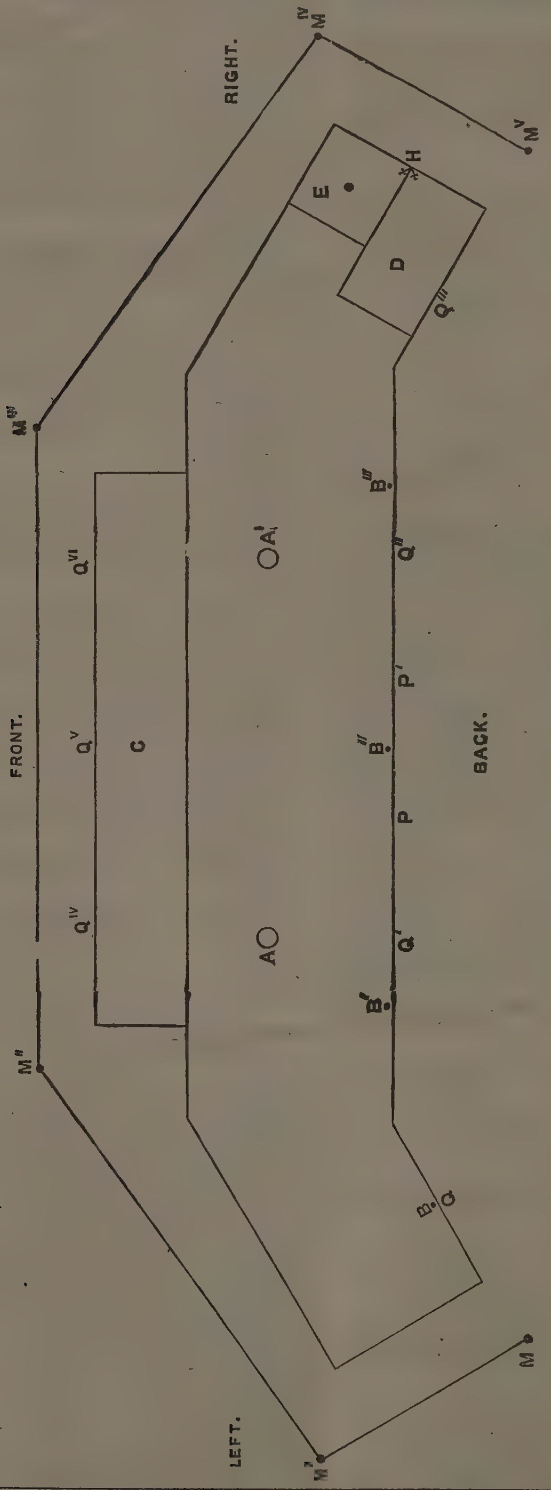
(A.) Those fittings which it would be *highly desirable* to have from the very commencement, regardless of those which may be put up hereafter as the necessity for them arises.

(B.) Those fittings (selected from the above) which are *absolutely* necessary, with a very short account of makeshifts for the rest.

(A.)

1. *Benches and Desks.*—Three concentric arrangements of benches and desks within the hemicycle. Breadth of benches 9 inches, of desks 12 inches. A space of about 1 foot between each desk and next interior bench. Each bench to be raised at least 1 foot above the next interior bench.

2. *Lecture Table* (*vide* Sketch):—8 feet long parallel to the diameter of the semicircle, with two returns of 2 feet each, at an angle of 150° with the main body of the table.



Plan of Table, half an inch to a foot.

A, A'	Down draughts.
B . . . B'''	Gas-pipes at edge of table.
C	Specimen table.
D	Trough, with waste-pipe.
E	Sink.
H	Taps for water.
M . . . M^{v}	Uprights for rope or rail.
Q . . . Q^{vi}	Cupboards.
P, P'	Position of drawers.

---

[*] Since this scheme was drawn up, the laboratory has been built, and some slight modifications have been made in the arrangements. The general plan, however, remains unaltered.

Breadth of table 2 feet 3 inches, height 2 feet 8 inches. The top of the table is to project about an inch over the face of the cupboards beneath; but there is also to be a groove along the surface all the way round, ½ an inch from the edge; this groove to be about ½ an inch broad and about ⅜ of an inch deep.

2*a*. *Drawers.*—In the centre of the table (P and P′) at least four drawers; if possible, two rows of three each. Each drawer to be about 2 feet long, 1 foot broad, and 3 inches deep.

2*b*. *Cupboards.*—(Q, Q′, &c.) to occupy the remainder of the space available for that purpose. These to be provided with one shelf about 1 foot above bottom of cupboard and coming to within ½ an inch of door; also with two sliding trays, 4 and 8 inches respectively from the top of the cupboard.

The cupboards should be as narrow as possible, say about 2 feet; the doors should revolve rather than slide; and the influx of dust should be prevented by having a protruding ledge within, which will overlap the cracks.

2*c*. *Trough* (D.).—In the right hand return, and at the back of the table, a pneumatic trough constructed of slate; dimensions, 1 foot broad, 1 foot and a half long, 1 foot deep. Interior to be quite plain, except that there must be a hole with plug at the bottom connected with waste-pipe. There should be a grating just below the plug to prevent stoppage, and a joint within easy reach.

The top edge of the trough (which will be about 1 inch thick) should be a little below the level of the table; and a wooden lid should be provided, which, when placed over the trough, will completely cover it and be flush with the table.

Tap (H) for water supply.

2*d*. *Sink* (E) of glazed stoneware, 1 foot in diameter, placed in front of trough. Waste pipe and plug of stoneware, on account of acids, &c.; joint within easy reach.

Tap (H) for water supply.

2*e*. *Down-draughts* (A, A′) of glazed stoneware, to come out at right hand of furnace, where, on a level with the floor, a small air-tight door is provided, within which is a ring of gas jets; thence to pass into the flue of furnace.

2*f*. *Gas Pipes* (B, B′, &c.)—One pair in left-hand return and three pairs along the central portion. All these should be as close as possible to the back edge of the table.

3. *Specimen Table* (C), to be placed in front of lecture table. Length 6 feet, breadth 1 foot, height 2 feet. The upper surface will be used solely for the display of specimens.

3*a*. *Cupboards*, for storing apparatus, &c. Beneath this table there should be a series of sliding trays, about 4 inches apart; doors to revolve; dust kept out as in 2*b*.

4. *Rope and Uprights*, round the lecture table and specimen table, as at M, M′, &c., to prevent boys from coming near enough to handle specimens, &c. The uprights should be about 2 feet high, as far from the table as the benches in front will permit, and so placed as not to interfere with the cupboards, 3*a*. The rope should be removable at pleasure.

5. *Blow-pipe Table*, placed near the back wall on the left of the still (*q. v.*).

6. *Slate*, on movable frame and rollers, 4 feet square. *Not black board.*

7. *Work Tables*, 3 feet long, 1 foot 9 inches broad, 3 feet high. Upper surface of slate (if of wood, this to be quite plain, neither painted, paraffined, nor stained, &c.); groove as with lecture table, and to project 3 inches over the cupboards beneath; there is to be no partition between any two contiguous desks, since 7 *a*, *b*, *d*, and *e* will be quite sufficient to indicate the limits of each; but they should be numbered as indicated below.

7*a*. *Cupboards.*—Beneath each table, a cupboard similar to 2b; except that there should be only one sliding tray 4 inches from top, and two shelves, one of which is 1 foot from bottom and the other midway between this and the tray, both coming to within an inch of the door. The doors should work on hinges placed horizontally beneath the surface of the tables, so that they could not be left open; in case of necessity they could be looped up by a simple contrivance.

7*b*. *Sinks*, 1 foot in diameter, of glazed stoneware; waste pipes of same, with plug, beneath which is grating; joints within easy reach. One sink for every two tables.

7*c*. *Tap*, for water supply; one for each table above sink.

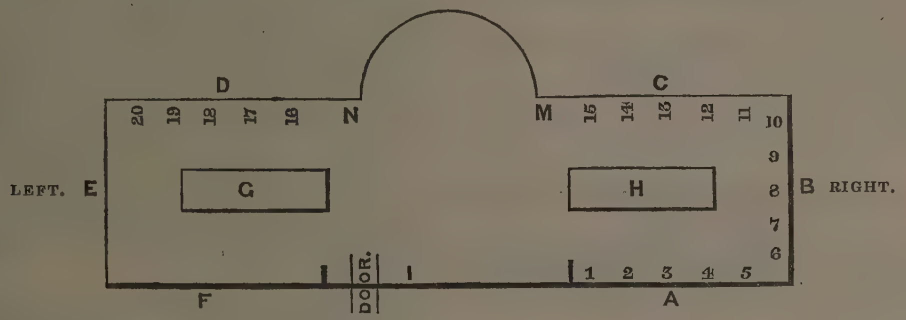
7*d*. *Gas Pipes.*—One pipe dividing into two smaller ones (one for each table), placed alternately with the sinks. Also above each sink one fish-tail burner for lighting purposes.

7*e*. *Shelves.* Four in number above each table; strongly fixed to the wall; about 4 inches deep. The first shelf to be 1 foot above table, the others 6 inches apart. The shelves of one table to be continuous with those of the adjacent tables, but to be separated from them by a narrow upright placed against the wall; these uprights may, but need not, come to the front.

7*f*. N.B. Number and arrangement of work tables.

There will be space for the following :—

Five each at A, B, C, D, E, and F, and 10 each at G and H. At present not more than 20 tables will be required; these should be those at A, B, C, and D, and they should be numbered from A onwards in regular succession. There will be two spaces of about five feet each left at M and N; these will be appropriated as follows :—



8. *Sink* at N., on the *left*-hand side, with tap and arrangements for washing and drying bottles, &c.

9. *Teacher's work table* at M., on the *right*-hand side, 5 feet long, 1 foot 9 inches broad, and 3 feet high; cupboards beneath with *revolving* doors and two drawers about 4 inches deep. Desk grooved. Separate sink, tap, and gas supply (two gas pipes in middle, *close to the wall*, and one at each end). Shelves above to be the same as with the other tables. This table will be used for the preparation of class experiments.

10. *Shelves* for large apparatus, &c. Against the wall and extending as far as the structure will permit, all round the room (except over the furnace), there should be two *firmly* fixed shelves supported at intervals with strong brackets. The lower one to be about 1 foot above the top shelf of the work-tables, and the other *not less* than 1 foot 3 inches higher. Depth about 8 inches.

11. *Cupboard* for specimens with glass doors fixed against the wall at a convenient height over the furnace. This cupboard should be very broad, and neither too high nor too deep, so that as many specimens as possible within it may be visible from outside, *e.g.* breadth 20 feet depth (internal) 6 inches, height (so that the top of it is) 9 ft. above floor. If it can be broader it can be lower in proportion, but the depth must not be less than 6 inches. If it cannot be so broad as 20 feet, it had better be a foot deep.

Uprights at intervals of 2 or 2½ ft. will serve to strengthen the shelves. The number of doors is immaterial. The shelves to be equidistant from each other, not less than 6 inches and not more than 8 inches apart.

12. *Furnace* and not a 6 ft. range, with plate and sand bath in the centre of the back wall. Facing the furnace there will be on the right of it the flue from the down draught of the lecture table. Still further on the right.

13. *Draught-cupboard* as long as possible, 2 ft. deep and 3 ft. high. Gas jet in flue at the back of a plate damper worked by pulley or spindle. The flue opens ultimately into the furnace flue.

14. *Still*, on separate fire, to be placed on left of furnace and close to it. Still further on the left will be the blowpipe table.

15. *Gas* burners or chandelier to supply light during lectures on foggy days.

16. *Paint;* the last coating *must* be of zinc paint; the last two if not three coatings *ought* to be.

17. *Exercise chest.* A small wooden chest, similar to that in the mathematical theatre of the college, but with a sliding door which can be altogether removed at pleasure and containing about 200 partitions to be placed at the back of the class benches in the centre of the semi-circumference of the hemicycle. Each partition to be about 2$\frac{5}{8}$ inches broad, 4 inches deep and $\frac{3}{4}$ of an inch high; ten in each horizontal row for the convenience of counting. The whole dimensions of the chest will, therefore, be about 2$\frac{1}{2}$ feet long, 2$\frac{1}{2}$ feet high, and 4 inches deep. To be placed about 3 feet above level of floor, so that an average boy can reach the top of it.

18. *Ladder*, self-supporting, and high enough to enable an average boy to reach the highest shelf in the room.

(B.)

Absolutely necessary—

The following:—

1, 2, 2*a*, 2*b*, 2*c*, 2*e*, 2*f*, 5, 6 [7, 7*a*, 7*b*, 7*c*, 7*d*, 7*e*?], 8, 9, 10, 12, 13, 14, 15, 16, 18.

With regard to those omitted and group 7, 7*a*, &c.,—

Makeshift for—

2*d*. The teacher will have to go without till he can get one put in.

3. A plain wooden shelf, 6 feet long, 1 foot broad, fitted on the table at a height of 2 feet above the floor.

3*a*. Go without till they can be obtained.

4. Do. do.

7, &c. If 20 cannot be put up, there should be as many as possible; and as the teacher's work table is indispensable, let those put up extend from it round the wall towards the furnace on the right-hand side of the room.

N.B.—The gas (7*d*) should be laid on, however, all round the room, and the shelves should be put up as described under 7*e*. The gas pipes round the room will be about 3 feet 1 inch above the floor.

As makeshifts for the remainder, the work-tables (so called) which have hitherto been used in the practical class; plain dissecting tables.

11. Almost indispensable, but the shelves (No. 10) might be used for a time in place of the cupboard.

17. Go without till it can be obtained.

August 22, 1872.

Remarks on Lecture Theatre and Laboratory of University College School.

It is proposed to have the laboratory and the lecture theatre in the new building now being constructed in one, and besides a few minor reasons, mere matters of convenience—

(1.) Because far more space will be thereby obtained for ventilating the lecture theatre, which would otherwise be of very small dimensions.

(2.) Because in future boys will be able, if they choose, to work at their tables during wet weather in play time, or spare hours; the master being engaged in the preparation of class work in the same room.

(3.) Because the laboratory will be larger than would otherwise have been the case.

(4.) Because it is by no means improbable that laboratory work will become far more extensive than at present; it may, therefore, be necessary to convert the *whole* of the room into a laboratory; it would then contain at least 100 working-tables; and this could be effected at a slight expense; a small lecture room, or even two, could be fitted up at a moderate expense, and no inconvenience would then arise from the rooms being separate, for under the supposed circumstances the staff of science masters would be greater than at present is found necessary.

MR. J. J. WALKER'S NOTES OF REPLIES to the ROYAL COMMISSIONERS ON SCIENCE INSTRUCTION as regards the TEACHING of NATURAL PHILOSOPHY:

i.e., Experimental Mechanics, Hydrostatics and Pneumatics and Optics.

X. (*a.*) All the instruction is oral; the lessons are alternately devoted to experimental demonstrations of general principles and to the working of illustrative exercises and problems on, or deductions from, these principles.

(*b.*) No books are used. Boys often ask for a book to be recommended, mostly such a one as shall be of most use in preparing for the matriculation examination of London University. They are advised to rely on their attentive observation of, sketches of the arrangements of the simple apparatus employed in, and careful notes on, the experimental demonstrations of all the fundamental principles of the parts of science which form the school course as actually exhibited.

(*c.*) Very little "practical work" is found possible under existing arrangements, and that is confined chiefly to the determination of specific gravity, actual observations and measurements for establishing the laws of reflection and refraction of light, and the effects of single, or combinations of, lenses and prisms, as also rhombs of Iceland spar. In planning the rooms now in course of construction, the extension of practical instruction has been provided for, to be limited only by the time at command.

XI. The best—indeed only thoroughly satisfactory—results are found to follow in the case of those boys who have not depended on books at all, but solely on the oral lessons and demonstrations.

XII. See answers to X. (*b.*) and XI.

XIII. (*a.*) The making notes is insisted on; they are in fact skeletons of the lessons, with sketches of the apparatus as actually used. Formal statements, or enunciations, of fundamental principles are usually dictated by the teacher, where precision of expression is of essential importance, but this always follows, and is aimed at being made to take the shape of deduction from, the previous experimental demonstration.

(*b.*) It is required that the notes should be revised (at home) after each lesson, and, if only roughly taken down at the time, copied fairly.

XIV. Under existing arrangements they do nothing of this kind.

XV. The nature of the subjects precludes the possibility of introducing any air of originality in the teaching, unless it may be in small details in which the common experiments, as usually described in books, are varied so as to baffle any attempt to repair, by cramming from books, inattention to what has been presented to observation. If any part of our course might be specialized, in answer to the question, it should, perhaps, be the practical knowledge the boys get of the nature of images formed by single, or combination of, lenses, by viewing all the varieties directly with the eye or by means of the screen. This practical study of the lens is always preceded by that of the prism, as an instrument for producing refraction only, subsequently as a dispersive instrument.

XVI. For some time the lecture room (fitted with presses for containing apparatus and materials, a lecturing and working table, with water and gas served, and furnished with the means of completely excluding daylight when required, during experiments on light) has only been free for the teaching of science during afternoon hours.

XVIII. The apparatus at command is sufficient in quantity for teaching the leading principles of mechanics, hydrostatics, pneumatics, and optics, but the greater part, bought some 15 or 20 years ago, is of a cheap description and consequently not as delicate or productive of as exact results as might be desired. Two years since the Committee of management authorised the outlay of from 15*l.* to 20*l.* in replacing some of this by improved apparatus, and about half that sum was actually expended in the department of optics chiefly, further outlay having been deferred until the completion of the new rooms. If the instruction of classes of from 20 to 25 were to become practical, a considerable increase in the quantity of apparatus would be necessary, but this chiefly of the less expensive parts. There is a small collection of well executed diagrams of sections and parts of the principal machines, and of some scientific processes of manufacture. It should be added, that such parts of the apparatus provided for the college professor as can be moved without risk of injury are available for school use.

XIX. There is no workshop for the use of the boys. Such repairs or modifications of the apparatus as appear necessary or desirable during its arrangement for each lesson, and which can be executed with common tools in a few minutes, the teacher does for himself. When repairs of more importance are required, the services of the assistant of the college professor are available, or those of the carpenter of the college.

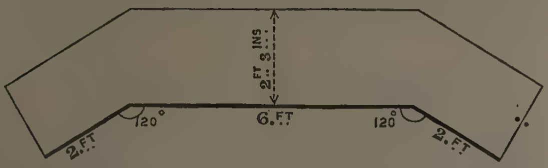
XXIII to XXV. By oral questioning, more or less, at every lesson. The demonstrations are, as much as practicable, drawn from the boys themselves by questions more or less "leading." The last two lessons of each month are devoted to a written examination, upon the results of which, chiefly, the "progress" of each boy is reported and his "place" in the class fixed. The note books at the same time are inspected and commendation for these given under the head of "diligence." If special occasion should seem to arise, the notes of particular boys are demanded for inspection at the close of the lesson, *e.g.*, in the case of any whose manner, or failure to answer the oral test questions put during the lesson, should indicate deficiency of attention. These tests are exclusively applied by the teacher of the class, and form the most laborious part of his work.

XXXIII. Every improvement the Universities introduce into their examinations must be attended with improvement in our teaching, *e.g.*, if the examinations of the University of London became partly practical in all departments of science, as they are, for instance, at University College in the case of botany, classes under instruction would be stimulated to much greater interest in, and attention to, the details of arrangement and manipulation of apparatus; and the substitution of practical instruction for teaching by the exhibition of experiments only must soon follow.

UNIVERSITY COLLEGE SCHOOL NATURAL PHILOSOPHY THEATRE FITTINGS.

1. Three concentric arrangements of benches and desks within the hemicycle. The breadth of benches 9 inches; of desks 12 inches. It is desirable that there should be a space of about 1 foot between each desk and next *interior* bench in order to allow of the master passing round to examine the pupils' work in the exercise class. It is very desirable that each bench should be raised at least 1 foot above the next interior bench, in order to give a clear view of the experimenting table to all.

2. The lecture table should be 6 feet long, parallel to the diameter of the semicircle, with two returns, at an angle of about 120° of about 2 feet each. Breadth about 2 feet 3 inches; height, 2 feet 6 inches; thus :—



3. Under the tables should be *cupboards* in preference to drawers, but it would be convenient to have an upper drawer, about 4 inches deep, in each return. One shelf (besides bottom) would be sufficient. It would be convenient if the top of the table projected about three inches over the face of the cupboard.

4. Behind the table, of course, will stand the blackboard or slate on a moveable frame. Dimensions 4 feet by 3.

5. Against the back wall a press about 7 feet high, 4 feet wide, and 2 feet deep.

6. Between the lecture table and the back wall four tables each, from 6 to 7 feet long, 2 feet 3 inches wide, for pupils' practical work. It might be desirable, in view of the possible appropriation of the theatre to examination purposes occasionally, that these should be moveable, or having feet screwed into the floor only.

7. It is understood that water would be laid on over a small trough or sink, and gas brought to the table.

8th July 1872.

FORM OF MONTHLY REPORT.—UNIVERSITY COLLEGE, LONDON: SCHOOL.

———'s Report for the Second Month of Michaelmas Term, 1872.

Rank of Class.	Subject.	No. of Boys in Class.	Average Place.	Conduct.	Diligence.	Progress.
	Greek - - -					
	Latin - - -					
	Latin Exercise -					
	Hebrew - - -					
	French - - -					
	German - - -					
	Italian - - -					
	Spanish - - -					
(Morning)	English - - -					
(Afternoon)	English - - -					
	Grecian History -					
	Roman History -					
	English History -					
	Geography - -					
	Social Science - -					
	Chemistry - -					
	Chemical Physics -					
	Natural Philosophy -					
	Astronomy - -					
	Applied Mathematics					
	Trigonometry, &c. -					
	Algebra - - -					
	Geometry, Plane -					
	Geometry, Practical -					
	Mensuration - -					
(Morning)	Arithmetic - -					
(Afternoon)	Arithmetic - -					
	Book-keeping - -					
	Writing - - -					
	(Freehand) Drawing - -					
	Perspective - - -					
	Model Drawing - - -					
	Mechanical Drawing - -					

No. of times late at beginning of—
Morning : Afternoon : M. Th. T. F. W. S.

SYMBOLS :—

1=" Very Good." 2=" Good." 3=" Tolerably Good."

To express decided blame, a *verbal entry* is used, unaccompanied by a symbol.

When a boy is about *to leave the school*, a written notice to that effect must be sent to the secretary before the end of the last term of his attendance. In case of omission to give such notice, the payment of a half term's fee will be enforced.

The school breaks up for the Christmas holidays on Wednesday, 18th December, at 12.30.

SCIENCE CLASSES.—PROGRAMME OF WORK.

CHEMICAL PHYSICS.

TEXT-BOOK.—ORME'S "INTRODUCTION TO THE SCIENCE OF HEAT."

1st Term.—General properties of matter. Molecular forces. Metric system (introd.). Heat and cold (general notions). Expansion (Chap. I). Expansion of solids; metallic thermometers and pyrometers; relative weight (II). Conduction of heat (III). Expansion of liquids; thermometers; relative weight; barometer (IV).

2nd Term.—Expansion of gases; air thermometers; thermoscopes; convection of heat; absolute and relative weights of gases and vapours (V). Evaporation; potential heat; vapour tension; liquefaction of gases; hygrometry (VI). Liquefaction of solids; freezing mixtures (VII). Effects of heat (VIII).

3rd Term.—Relative heat (IX). Theories of heat; laws of energy; work; mechanical equivalent of heat-unit (X). Relations between heat and chemical force (XI). Radiation; æther; theory of exchanges; formation of dew; diathermancy; transmission and absorption of heat (XII). Voltaic electricity. Electrolysis. Electro-magnetism. Ampère's theory. Magnets. Magneto-electricity. Electric telegraph. Frictional electricity. Leyden jar. Ohm's law.

The extent to which electricity and magnetism are treated depends upon the previous progress of the boys.

CHEMISTRY.

CLASS V.

1st Term.—Examination of some natural phenomena: Evaporation, liquefaction, melting, and freezing; clouds, rain, snow, fog, &c.; expansion; thermometers; conduction and convection of heat; relative weights of liquids and gases; air and atmospheric pressure; the barometer; combustion or chemical combination; compounds and mixtures; chemical elements; respiration.

2nd Term.—Further study of the composition, properties, and uses of air and water: oxygen; hydrogen; nitrogen; preparation, properties, and compounds of these elements. Animal heat; relative heat; potential heat.

3rd Term.—Practical study of the metric system; résumé of the work of the two previous terms; wood, coal, charcoal, coke, carbonic acid, coal gas, and flame; nitric acid, hydrochloric acid, and oil of vitriol; chlorine, sulphur, and phosphorus.

CLASS V.—UPPER.

TEXT-BOOK.—BARFF'S "INTRODUCTION TO SCIENTIFIC CHEMISTRY."

1st Term.—Oxygen. Hydrogen. Water. Nitrogen. Air. Ammonia. Oxides of nitrogen. Nitrates. (pp. 1–26; 39–70; 98–119.)

2nd Term.—Carbon. Hydrides and oxides of carbon. Carbonates. Chlorine, bromine, and iodine; their chief compounds. (pp. 27–38; 71–97; 121–160.)

3rd Term.—Sulphur. Sulphides. Oxides of sulphur. Sulphites. Sulphates. Phosphorus. Phosphides. Oxides of phosphorus. Phosphates. Silicon and silicates. (pp. 166–205.)

CLASS VI.—UPPER.

1. *Theoretical Course.*

TEXT-BOOK.—GILL'S "CHEMISTRY FOR SCHOOLS."

1st Term.—Oxygen. Hydrogen. Water. Nitrogen. Air. Ammonia. Oxides of nitrogen. Nitrates. (pp. 1–54; 131–166.)

2nd Term.—Carbon and its compounds. Chlorine, bromine, iodine, fluorine, sulphur; and their chief compounds. (pp. 213–252; 55–130.)

3rd Term.—Phosphorus, arsenic, antimony, bismuth, boron, silicon, tin; and their chief compounds (pp. 167–212, 253–274). Principal properties and compounds of silver, mercury, lead, copper, iron, manganese, zinc, barium, calcium, magnesium, sodium, potassium.

The extent to which the metals are treated depends upon the previous progress of the boys.

2. *Practical Course.*

1st Term.—The metric system. Quantitative study of length, area, volume, weight, relative weight, and solubility; preparation of oxygen, hydrogen, water, ammonia, hydric nitrate; and examination of the properties of those bodies.

2nd Term.—Preparation of carbonic acid, hydric chloride, hydric sulphate, sulphurous acid, hydric sulphide; and examination of the properties of those bodies. Properties of nitrates, chlorides, iodides, carbonates, sulphates, sulphites and sulphides.

3rd Term.—Properties of phosphates, arseniates and arsenites, borates, silicates, of the salts of arsenic, antimony, tin, silver, mercury, lead, copper, iron, manganese, zinc, barium, calcium, magnesium, potassium, sodium, ammonium.

The extent to which the metals are treated depends upon the previous progress of the boys.*

NATURAL PHILOSOPHY (EXPERIMENTAL).

1st Term.—Properties of rigid matter. Inertia. Mechanical forces. Weight. Pressure. Tension. Reaction. Equilibrium of two, of three, forces. Resultants. Systems of parallel forces. Centre of weight. Stable and unstable equilibrium. Stability. Mechanical powers and simple machines.

Uniform velocity. Newton's first law of motion. Variable velocity and its measure. Attwood's machine. Mass. Momentum. Newton's second law. Uniformly accelerated movement. Laws of falling bodies.

2nd Term.—Oscillations. The pendulum and applications. Principles of clock and watch work. Newton's third law of motion. Impact and collision. Elasticity. The spring balance. The torsion balance. Circular movement. Work and energy, with principle of conservation of molecular forces. Capillarity.

Properties of fluids. Hydrostatic pressure. Pascal's principle. Hydraulic press. Surface of equilibrium. Levelling instruments. Archimedes' principle. Specific weight. Elastic properties of air and steam. Boyle and Mariotte's law. Engines and instruments depending on atmospheric pressure. Elementary principles of the steam engine.

3rd Term.—Vibrations. Outline of theories of sound and light. Laws of reflexion. Images formed by plane and spherical mirrors. Laws of single refraction. Total reflexion. The prism and dispersion of light. Images formed by refraction at the surface of water. Lenses. Simple microscope. Telescopes and eye pieces. The sextant. Camera obscura. Stereoscope. Elements of double refraction and of polarization of light. First principles of spectrum analysis. Rainbows and halos.

The lessons to be devoted alternately to experimental demonstrations and explanations of general principles, and to illustrative exercises on, and deductions from, these.

MATHEMATICAL CLASSES.—PROGRAMME OF WORK.

GEOMETRY.

CLASS IV.—BEGINNERS.

1st Term.—*Practical Geometry.*

Such constructions as are required to work out the printed programme. Exercises involving the leading problems for home work, constructions drawn to scale, &c.

Three days a week for the first half term, two days a week for the second half term, when the class may begin.

---

* This programme will not apply to work in the new building. Text-books of any kind are now (1873) no longer used, except that in the Practical Class, "Harcourt and Madan's *Exercises*" is recommended.

Pure Geometry.

(*a.*) Elementary notions. Straight lines. Angles. Properties of triangles (Wright's Plane Geometry, §§ 1–39).

2nd Term.—*Practical Geometry*. One day a week.

(*b.*) Perpendiculars and obliques; equality of triangles; parallel lines; polygons; and easy exercises, pp. 12, 22, 30 39 (Wright, §§ 40–80). Two days a week.

3rd Term.—*Practical Geometry.* One day a week.

Pure Geometry.

(*c.*) Parallelograms; construction of triangles from given data, and other elementary problems, and exercises (Wright, §§ 81–86 126–134, or 138). Two days a week.

CLASS IV.—UPPER.

Practical Geometry. One day a week.
Pure Geometry.

1st Term (*b*), running over (*a*) again.
2nd Term (*c*).

3rd Term (*d*).—Equivalence of rectilineal figures (Wright §§ 272–301, 307–311), with exercises. Plane mensuration.

CLASS V.—LOWER.

Practical Geometry. One day a week.
Pure Geometry.

1st Term (*c*).
2nd Term (*d*).

3rd Term (*e*).—Properties of the circle (Wright, §§ 87–125, 135–146, 302–306; and exercises). Plane mensuration.

CLASS V.

Practical Geometry. One day a week.
Pure Geometry.

1st Term (*d*).
2nd Term (*e*).

3rd Term (*f*).—Ratio and proportion. Metrical properties of triangles and circles. Construction of proportionals (Wright, §§ 147–181, 201–224; and exercises). Plane mensuration.

CLASS V.—UPPER.

Practical Geometry. One day a week during first term.
Pure Geometry.

1st Term (*e*).
2nd Term (*f*).

3rd Term (*g*).—Properties of similar figures. Regular polygons and their areas. Area of circle. Circular sectors and circular segments (Wright, §§ 182–200, 225–271, 312 to end). Plane mensuration.

CLASS VI.

1st Term (*f*).
2nd Term (*g*).

3rd Term.—Elements of solid geometry: Sphere, cone, and cylinder (see Rouché, livres v. and vii.), Mensuration of solids.

⁂ Two periods in each month shall be given to the solution of exercises with this class. The exercises to be worked out at home by the class from scant notes and shown at the next succeeding geometry lesson,

Syllabus of Work in Geometry.

CLASS.	1st Term.	2nd Term.	3rd Term.
Fourth (Beginners) -	$P_3P_2(a)$	$P_1(b)$	$P_1(c)$
„ (Upper) - -	$P_1(b)$	$P_1(c)$	$P_1(d)$
Fifth (Lower) -	$P_1(c)$	$P_1(d)$	$P_1(e)$
„ - - - -	$P_1(d)$	$P_1(e)$	$P_1(f)$
„ (Upper) - -	$P_1(e)$	$L_1(f)$	$T_1(g)$
Sixth - - - -	$L_1(f)$	$T_1(g)$	T_1S
„ (Upper).			

Plane Mensuration should be commenced with classes reading Wright (*d*), and be continued in the higher divisions as illustrative of the subject matter of the text-book.

P_3 stands for Practical Geometry three times a week.

(*a*) Wright, §§ 1–39.
(*b*) „ 40–80.
(*c*) „ 81–86, 126–134, or 138.
(*d*) „ 272–301, 307–311.
(*e*) „ 87–125, 135–146, 302–306.
(*f*) „ 147–181, 201–224.
(*g*) „ 182–200, 225–271, 312 to end.

L_1, T_1 stand for Logarithms and Trigonometry, each one day a week.

S stands for Solid Geometry, as above.

ALGEBRA.

Syllabus of Work in Algebra.

CLASS.	1st Term.	2nd Term.	3rd Term
Beginning Fourth - -	*a*	*b*	*c′*
Upper Fourth	*b′*	*c*	*c′*
Lower Fifth - -	*c′*	*d*	*d′*
Fifth - - - -	*d′*	*e*	*f*
Upper Fifth - - -	*e*	*f*	*g*
Sixth - - - -	*h*	*i*	*k*
Upper Sixth.			

(*a*) Elements, first four rules, with use of brackets, simple equations of one unknown quantity, and easy problems.

(*b*) Resolution into factors; G.C.M.; L.C.M.; simple equations of one and two unknown quantities; easy problems.

(*c*) Fractions (easy); simple equations of two and three unknowns; square and cube root.

(*d*) Fractions (higher); evolution; quadratic equations of one unknown, and easy problems; progressions.

(*e*) Simultaneous equations involving quadratics; ratio, proportion, variation.

(*f*) Notation; surds and indices.

(*g*) Interest (without and with the use of logarithmic tables); annuities; indeterminate equations.

(*h*) Permutations and combinations; binomial theorem for positive integral exponent.

(*i*) Binomial theorem (in its generality); multinomial theorem; Horner's method of solving equations and extracting roots.

(*k*) Practice in all the rules.

N.B.—A letter accented thus (*b′*) is intended to include practice in the earlier rules.

APPLIED MATHEMATICS.

1st Term.—Mathematical proofs of the principles of elementary statics and uniformly accelerated rectilinear movement. Examples and problems.

2nd Term.—Hydrostatics and pneumatics, as treated by elementary mathematics, with examples and problems. Repetition of, and advanced exercises in, the work of 1st Term.

3rd Term.—Geometrical optics. Statical friction. Couples and equilibrium of co-planar forces generally. Guldin's thorems. Impact and collision. Centrifugal force. Projectiles. Rectilinear vibrations. Simple pendulum. D'Alembert's principle, with easy applications. Problems.

UNIVERSITY COLLEGE SCHOOL.—MORNING TIME TABLE.

Michaelmas Term, 1872.

PERIOD.	I.			II.			III.			IV. (MON., WED., FRI.)			IV. (TUES., THUR., SAT.)		
	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.
LATIN CLASSES	-	—	—	-	—	—	6 a.	28	X.	-	—	—	→	—	X.
	-	—	—	-	—	—	6 b.	7	Z.	—	—	—	—	—	—
	-	—	—	-	—	—	5	28	C.	→ a.	13	S.	→ b.	14	L.
	-	—	—	-	—	—	4 a.	25	S.	-	—	—	→	—	S.
	4 b.	20	D.	-	—	—	-	—	—	→	—	D.	—	—	—
	4 c.	22	O.	-	—	—	-	—	—	-	—	—	→	—	O.
	3 a.	20	Y.	-	—	—	-	—	—	→	—	Y.	—	—	—
	-	—	—	-	—	—	3 b.	23	Y.	-	—	—	→	—	Y.
	-	—	—	-	—	—	3 c.	16	M.	→	—	O.	—	—	—
	Upper 2	20	M.	-	—	—	-	—	—	→	—	M.	→	—	M.
	-	—	—	-	—	—	2 a.	19	J.	→	—	J.	→	—	J.
	-	—	—	-	—	—	2 b.	19	G.	→	—	G.	→	—	G.
	2 c.	20	G.	→	—	G.	—	—	—	—	—	—	—	—	—
	2 d.	18	C.	-	—	—	-	—	—	→	—	C.	→	—	C.
	Upper 1 a.	21	J.	→	—	J.	—	—	—	—	—	—	—	—	—
	Upper 1 b.	18	L.	-	—	—	→	—	L.	—	—	—	—	—	—
	-	—	—	-	—	—	1 a.	25	F.	→	—	F.	→	—	F.
	1 b.	23	F.	→	—	F.	-	—	—	—	—	—	—	—	—
	1 c.	19	E.	→	—	E.	-	—	—	—	—	—	—	—	—
	-	—	—	1 d.	21	O.	→	—	O.	—	—	—	—	—	—
	-	—	—	1 e.	27	Y.	—	—	—	—	—	—	—	—	—
GREEK CLASSES	-	—	—	6	19	S.	—	—	—	—	—	—	—	—	—
	-	—	—	Upper 5 a.	13	C.	—	—	—	—	—	—	—	—	—
	-	—	—	Upper 5 b.	18	L.	—	—	—	—	—	—	—	—	—
	-	—	—	5	20	M.	—	—	—	—	—	—	—	—	—
	-	—	—	Lower 5	19	X.	—	—	—	—	—	—	—	—	—
	4 a.	18	S.	4 b.	19	D.	—	—	—	—	—	—	—	—	—
FRENCH CLASSES	-	—	—	-	—	—	-	—	—	6	38	W.	—	—	—
	-	—	—	5 a.	16	U.	-	—	—	5 b.	17	Z.	5 c.	18	T.
	4 a.	16	Q.	4 b.	23	T.	-	—	—	4 c.	20	I.	4 d.	15	I.
	3 a.	24	W.	3 b.	20	Q.	3 c.	21	T.	3 d.	18	T.	3 e.	15	W.
	-	—	—	3 f.	23	I.	—	—	—	—	—	—	—	—	—
	2 a.	22	I.	2 b.	17	W.	2 c.	20	U.	2 d.	20	Q.	→	—	Q.
	Lower 2	24	T.	-	—	—	—	—	—	—	—	—	—	—	—
	1 a.	12	U.	-	—	—	1 b.	25	W.	—	—	—	—	—	—
	-	—	—	-	—	—	1 c.	21	I.	1 d.	25	U.	→	—	U.
	-	—	—	-	—	—	1 e.	30	Q.	—	—	—	—	—	—
ENGLISH CLASSES	-	—	—	Upper 5	15	H.	5	17	H.	—	—	—	—	—	—
	-	—	—	4 a.	25	B.	4 b.	20	D.	4 c.	16	L.	4 d.	23	D.
	-	—	—	3	27	P.	—	—	—	—	—	—	—	—	—
	-	—	—	2 a.	18	K.	2 b.	32	P.	—	—	—	—	—	—
	1	26	H.	—	—	—	—	—	—	—	—	—	—	—	—
MATHEMATICAL CLASSES	Upper 6	10	N.	—	—	—	—	—	—	—	—	—	—	—	—

University College School.—Morning Time Table. Michaelmas Term, 1872.—*continued.*

PERIOD.	I.						II.						III.						IV.			IV.		
	MON., WED., FRI.			TUES., THUR., SAT.			MON., WED., FRI.			TUES., THUR., SAT.			MON., WED., FRI.			TUES., THUR., SAT.			MON., WED., FRI.			TUES., THUR., SAT.		
	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.	Rank of Class.	No. of Boys.	Room.
GEOMETRY	Upper 5	7	R.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	5 *a.*	9	A.	. . .	—	—	. . .	—	—	. . .	—	—	5 *b.*	13	N.	—	—	—	—	—	—	—	—	—
	5 (Euclid)	26	V.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Lower 5 *a.*	19	B.	. . .	—	—	Lower 5 *b.*	18	A.	. . .	—	—	Lower 5 *c.*	17	B.	—	—	—	—	—	—	—	—	—
	Upper 4 *a.*	17	P.	. . .	—	—	. . .	—	—	. . .	—	—	Middle 4 *b.*	15	R.	—	—	—	—	—	—	—	—	—
	4 *a.*	23	X.	. . .	—	—	4 *b.*	19	R.	. . .	—	—	4 *c.*	23	A.	. . .	—	—	4 *d.*	18	N.	—	—	—
	. . .	—	—	. . .	—	—	4 *e.*	22	N.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ALGEBRA	. . .	—	—	Upper 5	14	R.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	. . .	—	—	5 *a.*	21	A.	. . .	—	—	. . .	—	—	. . .	—	—	5 *b.*	15	N.	—	—	—	—	—	—
	. . .	—	—	Lower 5 *a.*	24	B.	. . .	—	—	Lower 5 *b.*	19	A.	. . .	—	—	Lower 5 *c.*	13	B.	—	—	—	—	—	—
	. . .	—	—	Upper 4 *a.*	15	P.	. . .	—	—	. . .	—	—	. . .	—	—	Upper 4 *b.*	15	R.	—	—	—	—	—	—
	. . .	—	—	4 *a.*	21	X.	. . .	—	—	4 *b.*	19	R.	. . .	—	—	4 *c.*	25	A.	. . .	—	—	4 *d.*	25	N.
	. . .	—	—	. . .	—	—	. . .	—	—	4 *e.*	22	N.	—	—	—	—	—	—	—	—	—	—	—	—
ARITHMETIC CLASSES.	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	3	26	R.	→	—	R.
	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	Upper 2	23	A.	→	—	A.
	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	2	30	B.	→	—	B.
	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	1	7	H.	→	—	H.
BOOK-KEEPING	. . .	—	—	— *a.*	24	V.	. . .	—	—	. . .	—	—	. . .	—	—	. . .	—	—	— *b.*	27	P.	— *c.*	23	P.
WRITING	. . .	19	K.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

UNIVERSITY COLLEGE SCHOOL.—AFTERNOON TIME TABLE.

Michaelmas Term, 1872.

MONDAY AND THURSDAY.

Period.	I.				II.			III.		
Rank of Class.	Monday. Subject.	Thursday.	No. of Boys.	Room.	Subject.	No. of Boys.	Room.	Subject.	No. of Boys.	Room.
6	History Natural Philosophy (Exercises)		22 21 } 22 }	S. W.	English - -	28 — —	O. — —	Applied Mathematics } Upper 6	— 10	— W.
5	History (a.) Geography (a.) - - - -	- - Eng. (a.) 17 B. - - -	25 13 — — — —	O. M. — — — —	History (b.) - - Arithmetic (a.) - - Chemistry	28 — — 25 — — 30	S. — — W. — — Y.	History (c.) - - - - Greek History Chemistry (Upper 5)	27 — — — — 21 57	M. — — — — S. Y.
4	History (a.) Geography (a.) - Eng. (a.) 18 H. Eng. (f.) 23 B. Arithmetic (a.) - Arithmetic (e.)	- - - Eng. (b.) 21 H. - - - -	21 20 — 25 — 21	R. A. — X. — D.	History (b.) Geography (b.) - English (c.) - Arithmetic (b.) Arithmetic (d.) -	23 14 — 18 — 25 25 —	D. M. — J. — X. B. —	History (c.) Geography (c.) Geography (g.) - - Arithmetic (c.) - -	29 18 14 — — 28 — —	O. I Q. — — L. — —
3	- - Geography (a.) - Arithmetic (a.) Arithmetic (d.)		— — 27 — 24 21	— — Q. — L. T.	History (a.) History (e.) Geography (b.) - Arithmetic (b.) -	17 18 17 — 19 —	R. Q. P. — I. —	History (b.) - - English (a.) Arithmetic (c.) Arithmetic (e.)	21 — — 23 24 23	H. — — B. R. A.
2	- Geography (a.) - Arithmetic (a.) -		— 17 — 24 —	— P. — G. —	History (a.) - English (a.) Arithmetic (b.) -	20 — 22 26 —	F. — H. L. —	History (b.) - English (b.) Arithmetic (c.) Arithmetic (d.)	27 — 25 20 20	F. — J. X. I.
1	English Arithmetic (a.)		22 13	J. I.	Geography Arithmetic (b.)	25 15	A. G.	- Arithmetic (c.)	— 18	— D.
	Writing (a.) Writing (g.)		23 25	K. F.	Writing (b.) -	25 —	K. —	Writing (c.) -	29 —	K. —
GERMAN CLASSES.	4 a. N. 3 b. C.	3 a. N. 3 c. C.			Upper 6 5 b. Upper 3	24 17 21	N. C. T.	5 a. 6 4 b.	20 11 16	N. C. T.

TUESDAY AND FRIDAY.

Period.	I.				II.			III.		
Rank of Class.	Tuesday. Subject.	Friday.	No. of Boys.	Room.	Subject.	No. of Boys.	Room.	Subject.	No. of Boys.	Room.
6	Geography Natural Philosophy (Experimental)		21 25 } 22 }	W. Y.	Arithmetic Chemistry (Upper 6) -	17 18 —	W. Y. —	Applied Mathematics } Upper 6	— 10	— W.
5	- Geography (b.) Eng. (b.) 20 B. Arithmetic (b.) - - -	- - Eng. (c.) 22 B. - - - -	— 20 23 — — —	— M. R. — — —	- Geography (c.) English (d.) Arithmetic (c.) Arithmetic (d.) - -	— 17 22 15 18 — —	— P. H. R. A. — —	- Geography (d.) English (e.) - - Social Science Chemical Physics (Up. 5.)	— 21 16 — — 27 57	— P. O. — — S. Y.
4	History (d.) Geography (d.) - English (d.) Eng. (g.) 15 H. Arithmetic (a.) - -	- - - - Eng. (h.) 16 H. - - -	19 23 — 24 25 — —	O. Q. — J. X. — —	History (e.) Geography (e.) - - - Arithmetic (b.) Arithmetic (d.) Arithmetic (e.)	17 27 — — — 25 25 21	S. Q. — — — X. B. D.	History (f.) Geography (f.) - English (e.) - Arithmetic (c.) - -	15 20 — 23 — 28 — —	B. M. — J. — L. — —
3	History (c.) - Geography (c.) English (b.) Arithmetic (a.) -		22 — 23 16 24 —	S. — A. D. L. —	History (d.) - Geography (d.) - Arithmetic (b.) Arithmetic (d.)	17 — 16 — 19 21	O. — M. — I. T.	- - Geography (e.) English (c.) Arithmetic (c.) Arithmetic (e.)	— — 24 12 24 23	— — Q. H. R. A.
2	- Geography (b.) - Arithmetic (a.) -		— 22 — 24 —	— P. — G. —	- - English (c.) Arithmetic (b.) -	— — 29 26 —	— — J. L. —	History (c.) Geography (e.) - Arithmetic (c.) Arithmetic (d.)	21 23 — 20 20	F. T. — X. I.
1	History Arithmetic (a.)		29 13	F. I.	- Arithmetic (b.)	— 15	— G.	- Arithmetic (c.)	— 18	— D.
	Writing (d.) -		23 —	K. —	Writing (e.) Writing (h.)	32 35	K. F.	Writing (f.) -	29 —	K. —
GERMAN CLASSES.	Upper 6 N. 5 b. C. Upper 3 T.	5 a. N. 6 C. 4 b. T.			4 a. 3 b. -	21 26 —	N. C. —	3 a. 3 c.	23 25	N. C.

The Natural Philosophy Class consists of two Divisions, the one meeting during the hour of recreation, the other during the First Period of the Afternoon.

The Upper 6th Chemistry Class meets for Practical work in the Laboratory for two consecutive periods (=1 hour and a half) on Wednesday Afternoon.

The mode of classification adopted in University College School is explained in the "Special Prospectus," of which a copy is sent herewith.

It will be seen that each boy has his own programme of work, which, subject to the law of permutations, is not necessarily identical with that of any other boy.

The revision of all classes by promotion or degradation at the end of the session is universal. Each step, however, must be earned, that is, a boy must satisfy his master that he can and will follow the work of the rank of the class to which he is advanced.

Individual cases of promotion and degradation are of almost daily occurrence throughout the year. In future it is intended that no change shall be made during the last month of each term, but this will be the only limitation to the practice of *ad libitum* revision.

The advantages of the system are dwelt upon by the "School Committee" of the Council of the College in their recent report (*v.* accompanying extract).

The drawbacks are illustrated by a passage from Professor Key's report to the Council for the year 1853. (Extract appended.)

The School Honour List, now printing in a new form lately adopted by the Council, will show the exact programme of work of each boy attending the science classes, and his degree of proficiency in each subject of study. This is the nearest approach that can be made towards answering the Commissioners' questions.

It must be borne in mind that the school is not intended for boys above the age of from 16 to 17.

EXTRACT from the Report of the School Committee, adopted by the Council, Dec. 7, 1872.

The Committee believe that this excellent state of things is to a considerable extent attributable to the system which prevails in the school of frequently revising the classification of the pupils in all the subjects of study, so that a boy is not, as in many public schools, kept for a long time in any class which is either too high or too low for him, but may at any time be removed from a class which experience has shown is not suitable for him to one adapted as closely as possible to his actual requirements. In this way the opposite evils of disheartening a boy or of making him careless are equally avoided, and his interest in every part of his work is constantly maintained.

EXTRACT from Professor Key's Report.

The problem of putting all the various classes together is one exceedingly intricate, and almost of a mathematical character, so that one head alone can successfully work it out, and that only when left to uninterrupted quiet. This will easily be understood when it is recollected that a given boy may have made such different progress in his several classes that it may be expedient, if possible, to place him in classes altogether incongruous for all his studies of mathematics, Latin, Greek, French, etc.

Form A.

UNIVERSITY COLLEGE, LONDON: SCHOOL.

Programme of Work.

Boy's (1) Surname and (2) Initials. ____________

MORNING.

Period.	M., W., F.	Room.	T., Th., S.	Room.
1.				
2.				
3.				
4.				

AFTERNOON.

Period.	M., Th.	Room.	T., F.	Room.
1.				
2.				
3.				
Wed.				
Sat.				
"Between hours."				

Form B.

UNIVERSITY COLLEGE, LONDON: SCHOOL.

Programme of Work.

Boy's (1) Surname and (2) Initials. ____________

MORNING.

Period.	M., W., F.	Room.	T., Th., S.	Room.
1.				
2.				
3.				
4.				

AFTERNOON.

Period.	M.	Th.	Room.	T., F.	Room.
1.					
2.					
3.					
Wed.					
Sat.					
"Between hours."					

*** Form B. is for boys who attend different rooms, 1st period M. Th. afternoons.

Form C.

UNIVERSITY COLLEGE, LONDON: SCHOOL.

Programme of Work.

Boy's (1) Surname and (2) Initials. ____________

MORNING.

Period.	M., W., F.	Room.	T., Th., S.	Room.
1.				
2.				
3.				
4.				

AFTERNOON.

Period.	M., Th.	Room.	T.	F.	Room.
1.					
2.					
3.					
Wed.					
Sat.					
"Between hours."					

*** Form C. is for boys who attend different rooms 1st period T.F., afternoons.

UNIVERSITY COLLEGE, LONDON.

School.

Under the government of the Council of the College.

Special Prospectus.

The object of the "special prospectus," as distinguished from the "general prospectus," is to afford more detailed information to the parents of boys *already entered* in the school.

The paragraphs to which * is prefixed occur in the general prospectus likewise.

The information that follows is intended to enable parents to gauge more accurately the attainments of their boys, to watch their progress, and to give instructions in due time as the season approaches for commencing new subjects.

Explanations are given with regard to the standard course of studies and sequence of subjects; the mode of classification, conditions of promotion, nomenclature of classes, and qualifications for admission into beginning classes; the requirements in respect of home preparation; and the regulations relative to school books and dinner tickets.

Programme of the Normal Work of Boys in the Upper School.

Session.=Year. Normal Age of Pupil.	First. 10 years.	Second. 11 years.	Third. 12 years.	Fourth. 13 years.	Fifth. 14 years.	Sixth. 15 years.
Subjects.	Class.	Class.	Class.	Class.	Class.	Class.
English - - - -	1	2	3	4	5	6
Arithmetic - - -	1	2	3	4	5	6
Geography - - -	1	2	3	4	5	6
English History - - -	1	2	3	4	5	6
French - - - -	1	2	3	4	5	6
Latin - - - -	1	2	3	4	5	6
Drawing - - - -	1	2	3	4	5	6
Writing - - - -	1	2	3	4	—	—
German - - - -	—	—	3	4	5	6
Roman History - - -	—	—	3	4	5	6
Mathematics (Pure) - -	—	—	—	4	5	6
Greek - - - -	—	—	—	4	5	6
Social Science - - -	—	—	—	4	5	—
Astronomy (Elementary) -	—	—	—	—	5	—
Chemical Physics - - -	—	—	—	—	5	—
Grecian History - - -	—	—	—	—	5	6
Chemistry (Theoretical) -	—	—	—	—	5	6
Chemistry (Practical) - -	—	—	—	—	—	6
Natural Philosophy - -	—	—	—	—	—	6
Applied Mechanics - -	—	—	—	—	—	6

* Boys are admitted to the upper school at any age under 15, if on examination found competent to enter. Applications for admission after that age are considered on their merits.

* A boy entering the upper school at the age of 10 will, with ordinary industry, under favourable circumstances, have gone regularly through the entire curriculum of the school by the end of the session in which he completes his sixteenth year, and ought then to be qualified to pass the matriculation examination of the University of London, and to enter as a student of the college.

Mode of Classification.

There is no formal division of the school into classical and modern departments.

Boys are examined at entry and classified, with a view to their requirements, in each subject separately according to individual proficiency. Thus the same boy may be classed high in one subject and low in another.

* Parents are allowed to select the subjects in which their sons are to be instructed, as well subsequently as at entry. It is essential, however, in the former case, that their wishes should be made known *before* or, at latest, *at the commencement of* the session or term when beginning classes are formed. The head master, moreover, reserves the right of veto.

In most subjects beginning classes are formed as required at the commencement of each term.

Boys who purpose preparing for the matriculation examination of the University of London should give notice of their intention as early as possible.

Any subject can be omitted at the discretion of parents, provided that the filling up of the full period of the school hours is not thereby prevented.

The possibility of taking up the whole of the subject contained in the curriculum is of course subject to the limitation of school-hours.

The number of subjects taught in the junior classes is limited with the express purpose of preventing distraction.

The first day or two at the beginning of the session, which commences with the Michaelmas term, are necessarily spent almost entirely in the business of classification. The absence of boys at that time is a serious detriment to the whole school.

At that time each class below the sixth advances a step.

Boys who are reported by their class masters as not having made sufficient progress during the foregoing session, lose their promotion and repeat the work of the previous year.

On the other hand, it is not unusual for boys of superior age, industry, or ability to be allowed to skip a class. Not unfrequently, in similar cases, two steps are taken, at intervals, in the course of a single session.

Boys who have already gone through the ordinary sixth classes, and who remain in the school for another year, either continue in the same classes or are formed into superior classes, distinguished as "upper" sixth. The "upper" sixth is thus virtually a seventh-session class.

The distinctions of "upper" and "lower" as applied to classes below the sixth, imply no difference of year, but simply signify that the general proficiency of the class in question exceeds or falls below the normal standard. This is generally accounted for by the time of the original formation of the class, according as it dates from the beginning of a session or from some later term.

Where there are several classes of the same denomination in one subject, the letters A., B., C. are added for distinction's sake. No priority of rank is implied.

The average number of boys in a class is about 20.

Latin.—It is considered an advantage in the case of boys under 11 years of age not to have commenced Latin before entering the school.

Greek.—Boys below the third class of Latin are not allowed to begin Greek. In regard to taking up this subject the initiative rests with parents.

German.—Boys below the third class of English and the third class of arithmetic are not allowed to begin German. In regard to taking up this subject also the initiative rests with parents.

Hebrew.—There is no *fixed* limit of age for beginning this subject. Boys are received at various ages and degrees of proficiency, according to circumstances.

Early English.—Boys wishing to compete for the annual prize offered to the school by the Early English Text Society for proficiency in this subject are formed into a voluntary class, meeting out of ordinary school-hours.

Mathematics.—Boys who have reached the fourth class of arithmetic (below which standard they are disqualified) are expected to begin mathematics, unless their parents object.

Applied Mathematics.—It is advisable to reserve this subject, where practicable, for the seventh session.

Chemistry, Chemical Physics.—Boys who have reached the fifth class of arithmetic (below which standard they are disqualified) are expected to begin these subjects, unless their parents object. It is, however, essential that they should join the classes from the time of their formation, and this will generally be at the beginning of the Michaelmas Term.

Practical chemistry is an essential part of the second year's science course in conjunction with theoretical chemistry. In exceptional cases only, as where a boy is preparing for matriculation, are members of the junior or first year's class allowed to attend the practical class.

Book-keeping is taught where desired, in a one-year course, to boys sufficiently advanced in arithmetic. They are required to be qualified for a fifth or, at lowest, a fourth class in that subject. The best time for commencing book-keeping is at the beginning of the last complete session of a boy's attendance at the school.

Writing may be continued when necessary, later than the fourth session, even during ordinary school-hours. There is likewise an extra writing class on the Wednesday afternoon, open to boys who are unable to attend at other hours, or who require special attention in this subject.

Drawing.—Drawing is treated as, to some extent, an essential part of education. The general system of teaching is arranged to meet, so far as practicable, the requirements of business and professional life. There are special classes for instruction in mechanical drawing. Promotion in the drawing classes is not confined to any particular season. A boy who produces a good drawing, provided his conduct in the drawing class gives satisfaction also, is advanced without delay to the highest class he is fit for.

Fencing and gymnastics can be commenced at any age without restriction.

Whilst most of the above regulations rest on principle, some have regard only to the general convenience of classification.

HOME PREPARATION.

With a few exceptions (chiefly arithmetic and algebra classes, and some first-session classes in English subjects) every school class demands a certain amount of preparation out of school-hours.

* A boy is expected to give to the home preparation of his lessons about two hours on an average every evening. The time will of course vary with the age of the boy. Below 12, an hour will generally be sufficient; above 15, more than two hours may be required. Where a much shorter or a much longer time than the average is actually bestowed, parents are earnestly recommended to consult with the head master upon the subject. Preparation out of school-hours on the school premises is wholly discouraged, except in the case of boys of undoubted industry. Copying exercises renders both giver and receiver liable to grave punishment.

It is impossible so to distribute a boy's time as to equalize absolutely the nominal amount of work to be prepared for the following day. Lessons will necessarily be more numerous on some nights than on others, But, as it is always possible to foresee the extra pressure, boys should learn to make provision accordingly. Many of the lessons follow in regular sequence, and are fixed in quantity: so that a boy may well anticipate on his slacker nights some of the work which falls on the busier ones.

It is of the highest importance that parents should familiarize themselves with the mode in which their sons' time at school is distributed, and so with the precise subjects of the lessons which have to be prepared at home each evening; and that, with the view of providing an additional incentive to steady industry, they should observe from day to day the actual numbers from which the "average place" in each class, as recorded in the monthly report, is deduced. This information is supplied by the "number register," which each boy is required to keep. A careful examination and comparison of the monthly reports will powerfully conduce to the same end, especially if accompanied by some specific acknowledgment or reward rising in proportion to their excellence. Reports containing throughout under the headings of "Diligence" and "Conduct," ("Progress" not included), the highest symbol, viz. "1" (= "Very Good"), are known as "Perfect Reports," and a record is preserved of boys obtaining them.

Boys are presumed to have fully prepared their home work, unless provided with an excuse.

A few words of explanation written on the parent's address card constitute the readiest and most convenient form of excuse. In the case of brothers, a separate card should be furnished to each boy.

All excuses must be countersigned by the vice-master, and parents are desired to grant them as sparingly as possible.

SCHOOL BOOKS.

New books are furnished at the school, as required, to those boys whose parents desire it, much loss of time and misunderstanding being thereby avoided. It is desirable that all books used at the school, whether issued there or not, should be marked with the school stamp. Boys mislaying books or needing to have books bound, can be temporarily supplied with substitutes from the "loan library." No second copy of a book is issued without a written warrant from parents.

DINNER TICKETS.

Boys wishing to dine at the school are required to provide themselves with dinner tickets. These tickets are supplied "between hours" in room L, on prepayment only.

Tickets are issued either singly or in sheets of twenty, ten, or five. By buying them in sheets, requiring their production at home, and initialling them, parents may secure their sons against all temptation to misapply the money given for payment.

To prevent the sale or transference of tickets from one boy to another, the name of the boy in whose favour they are issued must be inserted in each ticket at the time of delivery. The tickets are examined during dinner by the presiding master.

Unused tickets will be taken back, on the written request of parents, at a discount of twopence a sheet or part of a sheet.

Boys unprovided with money may borrow from the vice-master to the extent of the price of a single ticket.

A specimen sheet of "Honour List" is given on the following page.

USE OF THE TABLES.

The Tables show, term by term, for each boy:—

(1.) His subjects of study, and the rank of his several classes:

(2.) The manner in which he acquitted himself at the examinations held at the close of the term, as evidenced by the number and degree of his honourable mentions:

(3.) The numbers of exceptionally good monthly reports obtained by him during the term.

(1.) *Rank of Classes.*

The rank of classes ranges from lower first, first, upper first (expressed in the tables by ɪ, 1, **1**), up to lower sixth, sixth, upper sixth (expressed in the tables by 6, 6, **6**).

It will be observed that in the case of certain subjects the rank of classes is not specified. In such instances the classes are either of *invariable* rank or of *indefinite* rank. To the former category belong the following:—**6**. applied mathematics; 6. natural philosophy; **5**. chemical physics; 5. astronomy; 5. Grecian history (ranked as sixth for sixth Latin boys only). Examples of the latter are social science, book-keeping, and writing.

The symbol — is employed to indicate *attendance at a class*, where this fact would not otherwise appear, as, for for example, under the headings of natural philosophy and writing, and in the foot notes.

The rank of each boy's classes varies according to his proficiency in his several subjects of study.

Owing to the peculiarity of classification indicated, a boy's general standing in the school is not obvious at sight. To define this, the arrangement by so-called "forms" is introduced.

The "form" or *mean* position of each boy is determined by calculating the average rank of all his classes.

(2.) *Honourable Mentions.*

Honourable mentions or "commendations" are of three degrees, viz.:—"commended," "highly commended," "very highly commended" (expressed in the tables by ᴄ, ʜ, ᴠ).

The "commendation" awarded to the first boy in the examination of any class, whether ᴄ, ʜ, or ᴠ, is printed in larger type, thus, C, H, V.

In some subjects all classes of the same rank are combined for examination. The "commendation" gained by the first boy in such aggregate examinations is distinguished by larger and heavier type, thus, **C, H, V**.

Absence from examinations is denoted by the symbols * and †, denoting respectively "*wholly* absent" and "*partially* absent."

Standing in the "term" column, these symbols apply to the examinations as a whole; elsewhere, the reference is limited to single specified examinations.

Absence from single examinations is then only indicated when commendations would in all probability have been earned.

* rather than † is employed in the case of boys absent from all other examinations except those in which they obtained commendations.

(3.) *Monthly Reports.*

In the last two columns of the tables are recorded the number of "perfect" reports and the number of "proximè" reports which a boy has obtained during the term. For each term three reports are given.

Monthly reports containing throughout, under the headings of "conduct" and "diligence," the highest symbol, viz., "1" = "very good," are known as "perfect" reports. Those which, but for the presence of a single "2" = "Good," would have been "perfect," are recognized as "proximè" reports.

SPECIMEN SHEET OF “HONOUR LIST.”

1, 2, 3, 4, 5, 6, denote *Lower* First Class, *Lower* Second Class, &c.
1, 2, 3, 4, 5, 6, denote First Class, Second Class, Third Class, &c.
1, 2, 3, 4, 5, 6, denote *Upper* First Class, *Upper* Second Class, &c.
— denotes “attended Class; * denotes “ *wholly* absent from Examination;” † denotes “*partially* absent.

c, h, v,=Commended, Highly commended, Very highly commended.
C, H, V=Ditto, *and further*, “First Boy in his Class.”
C, H, V=Ditto, ditto, *and further still*, “First in the Aggregate Examination.”

FORM.	NAME.	TERM.	Classics.		Modern Languages.				History.			Geography.	Social Science.	Natural Science.			Mathematics.		Arithmetic.	Book-keeping.	Writing.	Drawing.	No. of Reports.	
	N.B.—The small numerals refer to the footnotes, in which a Report is given of Subjects not provided for in the Tables.		Greek.	Latin.	French.	German.	English.		Grecian.	Roman.	English.			Chemistry.	Ch. Phy.	Nat. Ph.	Algebra.	Geometry.					Perfect.	Proxime.
							(Morn.)	(Aftn.)																
1	Abrahams, Arthur	Lent*		1	1		1	1			1	1							1		—			1
3	Aimé, Charles	Mich.		2	3			4			4	4					4	4	3 c		—			
		Lent		,,	,, c			,,			,,	,,					,,	,,	,,		—			
		Sum.		,,	,, h			,,			,,	,,					,,	,,	,,		—			
5	Alexander, Josias[1]	Mich.	5 c	4	3 c	5		5		4 h	5 c			**5**	—		**4**	**4**	5					
		Lent		,,	4	,,	5	,,		,,	,,			,,	—		,,	,,	,,					
		Sum.		,,	,, c	,, c	,, h	,,		,,	,,			,,	—		,,	,,	,,					
5	Althaus, Theodor Friedrich[2]	Mich.	**4**	**4** c	5 v	**6** v		4 h		**4** c	4 h	4					5	5	5 C		v			2
		Lent	,, h	,, h	,, v	,, v		,,		,, c	,, c	,, h					,, c	,,	,,		h		3	
		Sum.	,,	,, h	,, v	,, v		,, V		,, c	,, h	,, V					,,	,,	,, c		v		3	
5	Anderson, Robert[3]	Mich.	5	**4**	4 c					**4** h	5 c			**5**	—	—	5	5	5 c					
		Lent	,, c	4 c	,, c					**3**	,, H			,,	—	—	,,	,, c	,, h					
		Sum.	,,	,, h	,, v					,, v	,, V			,,	—	—	,,	,,	,, c			5 v		
2	Davidson, S.	Mich.		**1** V	1 V		4 V	4 c			4 c	4 c							2 V		h		3	
		Lent		,, V	,, V		,, V	,, V			,, v	,, v							,, V		h		3	
		Sum.		,, V	,, v		,, V	,, h			,, c	,, v							,, **V**		c		3	
5	Jennings, A. O.	Sum.	6 v	5 v	5 v	3 V		5 V	v	5 c	5 h	5 **V**					**5** h	**4** **V**	5 **V**		c	3 c	3	
5	Kikuchi, D. Y.[4]	Mich.	**4** V	3 V	5 v				H	3 V	4 V			5 V		V	**6** c	**6** c	6 V				3	
		Lent	,, V	**4** v	,, v				V	**4**	,, V			,, V		V	,, v	,, h	,, V				3	
		Sum.	,, V	,, v	,, V				V	,, v	,, V			,, V		V	,, h	,, h	,, V			**3** v	3	
6	Morley, H. F.[5]	Mich.	6 h	6 c	6 c				V	6 h	6 V	6 V		**6** V			**6** V	**6** V					3	
		Lent	,, h	,, c	,, h						,, V	,, V		,, V			,, V	,, V					2	
		Sum.	,, V	,, h	,, h						,, V	,, V		,, V			,, V	,, V					3	
5	Osler, R. S.[6]	Mich.	**5** V	**4**	4 V			5 h		**4** v	5 H	5 V		**5**	v		5	**5** **V**	5				3	
		Lent	,, V	,, V	,, V					,, V	,, H	,, V		,, V	V		,,	,, c	,,				3	
		Sum.	,, V	,, V	,, V					,, V	,, c	,, v		,, V	V		,,	,, c	,, c				3	

---

[1] Model drg., v.

[2] Trigon., 5 —. Germ. Essay, V.

Model Drg., v.

[4] Trigon., **6** c; c; h. Perspec., 5 v.

[5] Applied Math., V; V; V. Trigon., **6** V; V; V.

[6] Trigon., **5** c.

15. TAUNTON COLLEGE SCHOOL.

General Arrangements.

Question 1. How is the school classified?—Into upper, middle, and lower, each compartment being subdivided. The principle of classification is uniform, that is, there is no different arrangement of classes for different subjects; but each boy is placed according to his general fitness, and his marks, in all the subjects taught, determine his position in his form.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Necessary for all boys in the upper and middle schools.

Question 3. Copy of time table.—U., upper school; M., middle school.

——	—	1st Hour.	2nd Hour.	3rd Hour.	4th Hour.	5th Hour.	6th Hour.
Monday	U.	Scripture	Mathematics	Music	Mathematics	Greek or German.	Botany.
	M.		Latin		Greek or German.	Chemistry	Mathematics.
Tuesday	U.	Mathematics	French	Latin	Mathematics	English	Greek or German.
	M.	French	Latin	Mechanics	Greek or German.	Latin	English.
Wednesday	U.	Practical Chemistry.	Practical Chemistry.	Scripture.			
	M.	Latin	Latin	Latin.			
Thursday	U.	Latin and Greek	Mathematics	Greek or German.	English	Latin	Botany.
	M.	Mathematics	French	English	Mathematics	Greek or German.	Chemistry.
Friday	U.	Mathematics	Latin	Music	Latin	Chemistry	English.
	M.	Greek or German.	Mathematics		Mechanics	English	Latin.
Saturday	U.	Mathematics	French	Latin and Greek.			
	M.	French	Mathematics	Mathematics.			

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

In upper school:—

Scripture	2
English	3
Latin	5
Greek or German	4
Mathematics	7
Chemistry	3
Botany	2
Music	2
French	2
	30

In middle school:—

Scripture	2
English	4
Latin	6
Greek or German	3
Mathematics	6
Chemistry	2
Mechanics	2
Music	2
French	3
	30

Two papers in Latin, two in French, one in Greek or German, one in mathematics, and one in English, are done in the evenings of the week, and two hours a week are taken from playtime for the drawing classes.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

Advanced chemistry, 20 boys of about 16 years old.
Botany, do. do.
Elementary chemistry, 50 boys of about 14 years old.
Mechanics, do. do.

Question 6. Amount of knowledge required before the study of science is commenced.

The lower school has a weekly lesson with the head-master on elementary scientific topics, introductory to the formal study of science.

For the commencement of the study no other condition is required than promotion into the middle school, which involves a knowledge of arithmetic to decimal fractions, and of algebra to simple equations.

Question 7. Is any alternative or choice of subjects offered?—No.

What departments of science are preferred?

a. By parents?—Having no option they manifest no preference.

b. By the boys?—In fact the most popular subjects are chemistry and botany. But I believe that this is due to the special enthusiasm displayed in teaching these subjects, not to any interest inherent in the subjects. The most zealous and effective teacher will make his own subject the most popular, or, teaching several subjects, the subject which he loves best.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—I have nothing to add to the answer just given.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—We have endeavoured to give exactly the same value in school marks to science, mathematics, and languages.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—
  Of physiology, at present the whole; of botany, one half.
  Of chemistry, for the upper school, one third; for the middle school, the whole.
  Of mechanics, the whole.

(*b.*) Book work?—
  Books are used only out of school as an assistance to notes taken at the lectures.

(*c.*) Practical work?—
  Physiology, at present none, but this is evil and temporary.
  Botany, one half the time is given to dissections, schedule writing, and classification.
  In chemistry, the upper school gives two thirds of the time to practical work.

Question 11. Which form of lesson is found to be most effective?—Practical work unquestionably, and we aim at extending it in all subjects as our means and our teaching power increase.

But, for junior boys, oral teaching and demonstration, accompanied by *frequent examination*, are, for some time, almost exclusively necessary.

Question 12. How are text-books used, *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Almost always supplementary. A boy uses his own text-book, or consults the larger works in the school library, in aid of what he has learnt in his last lesson, and towards its reproduction in the next.

Question 13. Is the use of note books encouraged (*a*) during, or (*b*) after the lesson, and to what extent?—Note books are used freely during the lessons, are used as text-books afterwards, and form the subject matter of periodical examinations.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Very rarely between lessons, except in botany. In practical chemistry, each boy has his own apparatus and works his own experiments, but it is dangerous to give boys access to the laboratory without the presence of a master.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?—A description of our botanical teaching, with copies of our schedules, list of natural orders, &c., is in the hands of the Commissioners. [See pp. .]

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should if possible accompany this return.)

Probably the Commissioners will think that this question was sufficiently answered in my former communication. [See pp. .]

Question 17. Number of assistants and curators, and annual cost?—Probably the Commissioners will think that this question was sufficiently answered in my former communication. [See pp. .]

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—Probably the Commissioners will think that this question was sufficiently answered in my former communication.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—Not at present; but I contemplate apparatus—

(*a.*) For turning.
(*b.*) For casting and modelling.
(*c.*) For microscopical mounting.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—For seniors, Huxley's Physiology, Oliver's Botany, Lindley's Descriptive Botany, Roscoe's Chemistry, Newth's Natural Philosophy and Mechanics, Twisden's Practical Mechanics.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—

a. To Carpenter's Physiology, Cuvier's Regne Animal, the Ray Society's publications; many of the best works on Natural History.
b. To Watson's Cybele, the works of Babington, Bentham, Balfour, Hooker, Sowerby, Moore.
c. To the Microscopical Journal, the Micrographical Dictionary; many old and new works on the microscope.
d. To Miller's Elements of Chemistry, Ganot's Physics, Lardner's Handbooks, Harcourt and Madan's Practical Chemistry.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—Not at present.

Tests of Progress.

Question 23. How often is the work tested?—There are short examinations in the scientific work about once a month; longer papers in the examinations at the end of each half-year.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—By written questions.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—By the teachers during the half-year; by independent examiners at its close.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—I take care that at least one of the school prizes is given annually to some branch of science, but there is no special encouragement beyond this.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—

First, and by far the most important, the establishment of a science master. The subject suffers by being put into commission, however good may be the teachers who share it. It has been taken hitherto by the mathematical master and myself; and we have learnt, from our experience, that, of all possible topics of education, science most urgently requires a single representative professor, whatever aid he may receive from others.

Secondly. Specially constructed rooms and much enlarged apparatus. Our laboratory is of the roughest; our museum cases, which are rapidly increasing, have no special home; we have outgrown our botanical garden, and we have no workshops.

The governing body of the school is keenly alive to our wants and eager to supply them; but the immense expense of new buildings has left them for the present without means; and though they will probably feel justified in shortly granting us a science master, I see no immediate prospect of the other improvements I have stated.

Question 32. What are the principal obstacles to the teaching of science in your own school?—Covered by the previous answer.

Question 33. How could the Universities best assist science-teaching in schools?—Most materially, by making a certain amount of science compulsory in the matriculation and little-go examinations.

Also, Cambridge might include science in the list of subjects on which the Syndicate offer to examine schools.

And Oxford might rescind the mischievous rule which limits junior candidates in the local examination to five optional subjects. A candidate takes up Scripture because he must; Greek, Latin, and mathematics, because they are supposed to count higher than anything else in the marks awarded. For the fifth subject there remain science, French, and German, and in all but a few cases French is preferred to science. Why should not all be taken if all are taught?

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?—For some years to come, until science is thoroughly established, I think an annual Government inspection, with grants or prizes of moderate value or a reward for attendance, would work exceedingly well. But I hope ultimately to see the day when all boys at all schools shall undergo a compulsory public examination in science, as in every other subject taught, at least once a year.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?—I venture to enclose a paper which I read ten years ago before the British Association. That paper brought upon me a great mass of correspondence, and made me acquainted with the feelings of a very large number of schoolmasters. In almost every case their communications tell the same tale, willingness to introduce science, absolute ignorance as to methods and systems, and eager desire for *minute practical guidance from some* *recognised authority.* I believe that a well-considered formula, laying down the hours demanded by science, the age when it should be commenced, the subjects to be taught, the order in which they must be taken, the text-books to be used, the apparatus necessary, would be immediately adopted and acted upon by a very large number of schoolmasters.

W. Tuckwell,
Head Master.

December 21, 1872.

[*See* Supplementary Report in p. 199.]

---

16. King's College School, London.

General Arrangements.

Question 1. How is the school classified?
(1.) A. Classical Department.
(2.) B. Modern Department.
(3.) C. Preparatory or Lower school.

The following is the distribution of the classes :—

Classical Side.	*Modern Side.*
Upper Sixth.	* Upper Sixth.
Lower Sixth.	* Lower Sixth.
Upper Fifth.	* Upper Fifth.
* *Senior Matriculation Class.*	* Middle Fifth.
* *Junior Matriculation Class.*	
Lower Fifth.	* Lower Fifth.
* *Fourth.*	* Upper Fourth.
	* Lower Fourth.
* *Remove.*	* Upper Remove.
	* Lower Remove.

Science Class.

Commercial Class.

Lower School.

* Third.
Upper Second.
Lower Second.
* Upper First.
Middle First.
Lower First.

The classes marked * attend lectures on science and take up class-books on science.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?

Science is a necessary part of the school course—

(1.) In the matriculation, fourth, and remove classes of the classical division.

(2.) In the whole of the Modern Department, excepting the commercial and special classes.

(3.) In the Third and Upper First classes of the lower school.

(*a.*) The Elementary Physical Class is attended by the Fourth and Remove (A), the Upper and Lower Fourth, Upper and Lower Remove (B), the Third and Upper First (C).

(*b.*) The Chemical Class is attended by the Matriculation Class (A), and Upper and Middle Mathematical Classes (B), and by a few boys who join for the Practical Chemistry.

(*c.*) The Advanced Physical Class is attended by the First, Fifth, Upper and Lower Fourth Matriculation Classes (B).

Question 3. Copy of time table?

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes.

(1.) Advanced class of natural philosophy.
35. Average age, 16.

(2.) Chemistry class.
54. Average age just under 16.

(3.) Elementary class in physics.
160. Average age, slightly under 15.

Question 6. Amount of knowledge required before the study of science is commenced?

(1.) *In the Elementary Class* no special knowledge is required. It includes the bulk of the middle portion of the school.

(2.) *In the Chemistry Class*, boys must have done Euclid I., II., and algebra as far as simple equations.

(3.) *In the Higher Physical Class*, boys must have done Euclid I., II., III., and algebra as far as quadratics.

Question 7. Is any alternative or choice of subjects offered?—None, except in very special cases.

What departments of science are preferred?

a. By parents?
(1.) Natural philosophy.
(2.) Chemistry.
(3.) Practical work in the laboratories.

b. By the boys?
(1.) Chemistry.
(2.) Practical work in the laboratories and the workshop.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—Chemistry and natural philosophy.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—None in determining his position, but his marks for science are added to his class marks to obtain a prize.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?

In physical classes.

(1.) *one lecture* per week to each class, 1 hour and a quarter for higher classes, ¾ of an hour for elementary classes.

(2.) *In Chemistry Class*, lecture and demonstration 1 hour.

(*b.*) Book work?

One hour and a quarter of book work with a class master.

(*c.*) Practical work?

20 boys do practical chemistry two hours per week.

One special boy does considerably more during the week.

A few boys go into the physical laboratory.

Question 11. Which form of lesson is found to be most effective?—Where the oral teaching of the lecturer is followed by the use of the text-book.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—The text-books are used *both for supplementary and preparatory work.* The lecturer gives out the subject of the next lecture, and in the meantime the boys have to get up the subject in the text-book. They thus know something beforehand of the experiments which they see, and are also practised in working out chemical formulæ.

Question.13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?

(*a.*) Every boy has to take notes of the lecture, and,

(*b.*) From those he draws up a full account of the lecture out of school hours, and illustrates it with diagrams of the experiments. These "accounts" are marked according to merit.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—No boy is *required* to work experiments at home, but several do, and the demonstrator in chemistry assists them readily with advice, and supplies them with substances for testing, &c.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how it is used?

(Plans and descriptions of these, with statements of their cost and annual expense, should if possible accompany this return.)

We have the use *with the College* of a third physical and chemical laboratory and three lecture rooms.

Question 17. Number of assistants and curators, and annual cost.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—We have a workshop *in common with the College.* The regular workdays are the afternoons of the half-holidays, Wednesday and Saturday. The number of boys in attendance is 39. Of these—

(*a*) 26 are engaged in wood-work, such as carpenters' and cabinet makers'.

(*b*) 6 do wood-turning.

(*c*) 7 are doing more advanced kinds of wood-work.

After completing a course in wood-work, they commence iron-work, and construct lathes and small steam-engines, boilers, and models of machinery of various sorts.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes.

(1.) *For Chemistry*—
Miller's Introductory Text-book.
Roscoe's Chemistry Class-book.

(2.) *For Natural Philosophy*—
Ganot's "Physics."
Parkinson's "Mechanics."
Todhunter's "Mechanics."
Besant's "Hydrostatics."
Ferguson's "Electricity."

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—To the books kept by the senior mathematical master, and such books as they can get lent them at home.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—No.

Tests of Progress.

Question 23. How often is the work tested?—By examination at the end of every term, and by questions at every lecture.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?

1. By questions in lecture.
2. By examination of note books.
3. By written examination at the close of each term.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?

1. Both the Physical Science classes are examined by the lecturer himself.
2. In the Chemistry class—
    (*a*) The lecturer examines at the close of term.
    (*b*) A regular class master examines also each day.

As yet we have not employed an independent examiner.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—The choice is very limited.

Question 27. Where are the best obtained? Have they been specially trained for the work, and if so, in what does such training consist?

Question 28. What evidence of scientific qualification rendered by candidates is found to be of most value?

Question 29. Can you state any results of science teaching in the school? such as—

(*a*) Success, professional or otherwise, of individual scholars.

(*b*) Influence upon the general studies and intellectual life of the school.

1. A Natural Science scholarship at Christ's College, Cambridge.
2. Honours in Botany and Zoology at the London University.
3. Royal Exhibition at the School of Mines, and Exhibition of 50*l.* for three years.
4. Prizes and Exhibitions at King's College, London.
5. Science Scholarship at Owens College, Manchester.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?

A. *Terminal prizes.*

(*a.*) One to the best boy in each of the upper classes, rank being determined by the term's work and examinations.

(*b.*) Three to the best boys in the large elementary class, one being selected from each of the three divisions, A, B, and C.

B. *Annual prizes.*

One for Natural Philosophy.
One for Chemistry.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—Improvements could be effected—

1. By the appointment of separate science masters for the school, independently of the College.
2. By the establishment of an independent laboratory, so that all who attend lectures and do the book work might also do practical work.
3. By the appointment of independent examiners to test the work.
4. By requiring of the lecturer in chemistry that he should also take the classes in their book work.

Question 32. What are the principal obstacles to the teaching of science in your own school?

1. The necessity of accommodating the hours of science lectures to the arrangements of the college.
2. The absence of science masters wholly devoted to the school and its interests.
3. The late age at which many boys join the school, especially the modern department.
4. The backward state in which they come to us.
5. The rapidity with which boys almost inevitably pass through the modern department.

Question 33. How could the Universities best assist science-teaching in schools?

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?—By donations of scientific books to form a school library of science, and scientific specimens and instruments of various kinds.

Question 35. Have you any other information to give, suggestion to make, likely to be helpful to the Commissioners?

G. F. Maclear, D.D.,
December 21, 1872. Head Master.

KING'S COLLEGE SCHOOL, LONDON.

Engineering Workshops.

1. Engineering workshops have been established for some years for the joint use of students at King's College and boys at King's College School.

2. They have recently been considerably enlarged by the addition of another floor for wood work, and have been also improved by the addition of a planing machine for metal work, and by the introduction of a steam engine.

3. The following is the general scheme of work:—

4. Students or boys of the first year, on joining the department, are made acquainted with the different tools, and their practical application to the purposes of carpenters' and joiners' work, by going through the processes

of preparing the wood, setting out and forming, from figured drawings prepared by themselves, the various joints used in constructions of wood, after which they are employed in making models in which the preceding joints are combined, so as to form trusses for roofs, bridges, girders, and other framing, required for buildings and other purposes.

5. Students are then enabled in their third term to proceed with the construction of models of various sorts, in illustration of the different apparatus used in practical mechanics, manufactures, and philosophical experiments, which involve the necessity of turning, for which purpose they are instructed in the use of tools for turning soft wood, hard wood, ivory, and other substances, and also in the mode of preparing and fixing the work in the lathe. The formation of cycloidal, epicycloidal, and involute teeth, for wheels, pinions, racks, &c. They are also instructed in the method of working in sheet metals and soldering.

6. Second year's students commence metal work, the operations of which consist of the various processes of chipping, filing, fitting, turning, boring, screw-cutting, and planing, the construction of foundry patterns in wood or metal and core-boxes.

These students are also instructed in forging wrought iron and steel, and in Easter term a moulder attends who gives practical instruction in the art of moulding.

7. With proper attention to the foregoing routine of procedure, the students become sufficiently proficient to be enabled to make for themselves lathes, and the apparatus connected with them, tools of various sorts, working models of steam-engines, boilers, and other machinery, in the construction of which either metal or wood, or the two combined, are employed.

The third year's students continue the second year's subjects, and in addition they are encouraged to make experiments on the strength of arches, beams, and girders are constructed from working drawings made by the students themselves.

8. At the termination of the year a prize is given, in each year, for proficiency in the execution of some piece of mechanism, the subject of which is given out during the Lent or Easter term.

In order to obtain a prize in either the second or the third year, the student is required to send in with his model or machine a finished form, dry pattern, with core-boxes, &c., of at least one of the castings used in such machinery or models, which pattern he shall himself have made, accompanied by working drawings of such machinery, also made by himself.

Every student is expected to furnish himself with a set of the simplest tools requisite for working in wood and metals. In order to diminish the expense of these tools as much as possible, the student may purchase them at the College; and upon his leaving they will be repurchased from him at a reduction depending on the condition in which they are returned.

9. No student is allowed to obtain tools or materials in the workshop to a greater amount than 4*l.* in any one term, without the consent in writing of his parent or guardian.

REGULATIONS to be observed by STUDENTS in the COLLEGE WORKSHOPS.

1. No student is allowed to wear the college gown in the workshops, or a coat with long skirts or loose sleeves, or to work in shirt-sleeves without their being turned up so as to be out of the way. No aprons may be worn by students when using any of the machines driven by steam power.

2. No student is allowed under any circumstances to interfere with any of the machines, except the machine with which he is actually engaged at work.

3. No student is allowed to interfere in any way with the bell signals, or to give the signal for starting or stopping the engine, unless requested to do so by the superintendent or foreman, or in case of an accident.

4. The regular signal for starting or stopping the engine will be three distinct strokes of the bell; and whenever the signal is given for stopping the engine, all machines must immediately be thrown out of gear. The same signal will be given for the engine room, always previous to starting or stopping the engine.

5. No student is admitted to the engine room without the permission of the superintendent, and when admitted he is not to touch any of the gauge cocks, valves, or any of the gear belonging to the engine or boiler.

6. The stationary adjustments of the lathes and machines are not to be altered in any way, without application to the superintendent or foreman.

7. Students must be careful in using those tools which are provided by the college for general use, to preserve them from injury, and to return them to the places appointed by the superintendent in a clean state. Students will be charged on any damage done, or loss sustained.

8. No fresh materials are to be cut off or used without previous application to the superintendent or foreman.

9. No unnecessary noise must be made, and playing or throwing missiles of any kind is strictly prohibited.

10. No sawing or chiselling is allowed upon the benches, except with the use of the bench-piece provided for that purpose.

11. Students must be careful in the continual preservation of their own tools, for the good condition of which they are responsible.

12. All tool-boxes are to be kept under the benches as far as the space will permit.

13. Students are to keep to their own work, and not to walk about the shop so as to be in the way, or to hinder other students when at work.

14. No student can be admitted into the workshops at any other hours than those mentioned in the time table, without previous permission of the Dean of the department, as well as that of the superintendent. This sanction will only be given on condition that the applicant is not thereby neglecting other duties in the college.

No student can, however, be permitted to occupy the time of, or have any assistance from, the workmen out of the regular hours of attendance named in the calendar.

The infringement of this rule by any student will have the effect of causing him to be entirely shut out from the workshops during the period not specified in the calendar for regular attendance.

---

17. MANCHESTER GRAMMAR SCHOOL.

General Arrangements.

Question 1. How is the school classified ?—Classification of school for 1873.—There are 550 boys in the school, divided for the purpose of general instruction into 21 forms.

Eleven are classical.

Parallel to the lower five of these are five modern language forms, and parallel to the upper half are four Science forms and one Mathematical form.

In the Science and Mathematical forms the boy has his choice between the study of classics and modern languages.

For the purpose of mathematical teaching all the forms below the Three Sixths, Science, Classical, and Mathematical are re-distributed into three groups, each consisting of five sets.

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments ?—Science constitutes the principal part of the teaching of the four Science forms, and an essential part of the teaching of the Mathematical Sixth.

There are, besides, optional classes for the teaching of Mechanics, Elementary Chemistry, and Physical Geography, drawn from all parts of the school.

Question 3. Copy of time table, see pp. 180–182.

Time Table for 1873

—		Hours.	Classical VI.	Mathematical VI.	Science VI.	Science Transitus.	Science V.	Science Remove.	Classical Transitus.	Upper Classical V.	Lower Classical V.
MONDAY.	1	9.15 to 10.45	Classics.	Classics or Modern Language.	Classics or Modern Language.	Physics.	Chemistry.	Mathematics.	Classics.	Classics.	Drawing.
	2	11 to 12.30	Classics.	Mathematics.	Physics.	Classics or Modern Language.	Classics or Modern Language.	Chemistry.	French.	Classics.	Classics.
	3	1.45 to 3	Classics.	Physics.	Chemistry.	Chemistry.	Model and Machine Drawing.	Mathematics.	Classics.	English.	Classics.
	4	3 to 4	Mathematics.	Physics.	Chemistry.	Chemistry.	Practical Geometry.	French.	Classics.	French.	English.
TUESDAY.	1	9.15 to 10.45	Classics.	Mathematics.	Mathematics.	Classics or Modern Language.	Classics or Modern Language.	English.	Classics.	Classics.	Classics.
	2	11 to 12.30	Classics.	Classics or Modern Language.	Classics or Modern Language.	Mathematics.	Mathematics.	Physics.	Mathematics.	Mathematics.	Mathematics.
	3	1.45 to 3	Classics.	Model and Machine Drawing.	Physics.	Model and Machine Drawing.	Chemistry.	Mathematics.	Classics.	Classics.	Drawing.
	4	3 to 4	French.	Practical Geometry.	Physics.	Practical Geometry.	Chemistry.	French.	Classics.	French.	Classics.
WEDNESDAY.	1	9.15 to 10.45	Classics.	Mathematics.	Mathematics.	Classics or Modern Language.	Classics or Modern Language.	French.	Classics.	Classics.	Classics.
	2	11 to 12.30	Classics.	Classics or Modern Language.	Classics or Modern Language.	Mathematics.	Mathematics.	Physics.	Mathematics.	Mathematics.	Mathematics.
	3	1.45 to 3	German.	Physics.	Chemistry.	Chemistry.	Model and Machine Drawing.	Mathematics.	Classics.	Classics.	Classics.
	4	3 to 4	Classics.	Physics.	Chemistry.	Chemistry.	Practical Geometry.	Drawing and Writing.	Classics.	Drawing.	French.
THURSDAY.	1	9.15 to 10.45	Classics.	Classics or Modern Language.	Classics or Modern Language.	Mathematics.	Mathematics.	Chemistry.	Mathematics.	Mathematics.	Mathematics.
	2	11 to 12.30	Classics.	Mathematics.	Physics.	Classics or Modern Language.	Classics or Modern Language.	French.	Classics.	Classics.	Classics.
	3	1.45 to 3	Mathematics.	Model and Machine Drawing.	Chemistry.	Chemistry.	Physics.	Mathematics.	Classics.	Classics.	English.
	4	3 to 4	Classics.	Practical Geometry.	Chemistry.	Chemistry.	Physics.	Drawing and Writing.	Classics.	German.	French.
FRIDAY.	1	9.15 to 10.45	Classics.	Classics or Modern Language.	Classics or Modern Language.	Mathematics.	Mathematics.	Physics.	Mathematics.	Mathematics.	Mathematics.
	2	11 to 12.30	Classics.	Mathematics.	Model and Machine Drawing.	Model and Machine Drawing.	Chemistry.	French.	German.	Classics.	Classics.
		1.45 to 3	French.	Mathematics.	Practical Geometry.	Practical Geometry.	Physics.	History and Geography.	Classics.	Classics.	French.
	4	3 to 4	Classics.	Mathematics.	Mathematics.	Classics or Modern Language.	Classics or Modern Language.	Drawing and Writing.	Classics.	Drawing.	Classics.

Time Table for 1873.

Modern Language Remove.	Classical Remove.	Classical IV.	Classical III.	Classical II.	Upper Classical I.	Lower Classical I.	French III.	French II.	Upper French I.	Middle French I.	Lower French I.
English.	Classics.	Drawing and Writing.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Drawing and Writing.	French.	French.	French.
French.	Drawing and Writing.	Classics.	Classics.	English.	Classics.	Classics.	Drawing and Writing.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
German.	Classics.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	English.	French.	Drawing and Writing.	Drawing and Writing.
Drawing and Writing.	English.	English.	Drawing and Writing.	French.	French.	English.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
French.	Classics.	Classics.	Drawing and Writing.	Drawing and Writing.	Drawing and Writing.	Drawing and Writing.	English.	French.	English.	English.	English.
Mathematics.	Mathematics.	Mathematics.	Classics.	Classics.	Classics.	Classics.	French.	Drawing and Writing.	Drawing and Writing.	French.	French.
English.	Classics.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	English.	French.	French.	French.
German.	French.	Classics.	English.	History and Geography.	English.	French.	Drawing and Writing.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
French.	Classics.	English.	French.	Drawing and Writing.	Drawing and Writing.	Classics.	English.	Drawing and Writing.	History and Geography.	History and Geography.	History and Geography.
Mathematics.	Mathematics.	Mathematics.	Classics.	Classics.	Classics.	Drawing and Writing.	Drawing and Writing.	French.	French.	French.	Drawing and Writing.
German.	Classics.	Drawing and Writing.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	French.	French.	French.	French.
History and Geography.	English.	Classics.	Drawing and Writing.	French.	French.	English.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
Mathematics.	Mathematics.	Mathematics.	Classics.	Classics.	Classics.	Drawing and Writing.	French.	French.	Drawing and Writing.	Drawing and Writing.	French.
French.	Drawing and Writing.	Classics.	History and Geography.	English.	Drawing and Writing.	French.	Drawing and Writing.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
German.	Classics.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	Mathematics.	History and Geography.	French.	French.	Drawing and Writing.
Drawing and Writing.	History and Geography.	History and Geography.	French.	Classics.	Classics.	History and Geography.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
Mathematics.	Mathematics.	Mathematics.	Classics.	Classics.	Classics.	English.	English.	French.	French.	French.	Drawing and Writing.
German.	French.	Classics.	Classics.	Drawing and Writing.	English.	Classics.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
Drawing and Writing.	Classics.	Classics.	French.	Classics.	History and Geography.	Classics.	French.	Mathematics.	Mathematics.	Mathematics.	Mathematics.
French.	Drawing and Writing.	Drawing and Writing.	English.	French.	French.	Classics.	History and Geography.	English.	English.	English.	English.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

TIME TABLE for 1873.

—	Classical VI.	Mathematical VI.	Science VI.	Science Transitus.	Science V.	Science Remove.	Classical Transitus.	Upper Classical V.	Lower Classical V.	Classical Remove.	Modern Language Remove.	Classical IV.	Classical III.	Classical II.	Upper Classical I.	Lower Classical I.	French III.	French II.	Upper French I.	Middle French I.	Lower French I.
Classics - - -	20½	7½[5]	7½	7	7	—	17¼	14	12	10¾[4]	—	9¼	9	8¼	8½	8¼	—	—	—	—	—
Modern Languages -	3½	7½	7½	7	7	6¾	3	3	3¼	2½	13¼	3¾	3¾	3	3	2½	8¾	7¼	9½	9¾	7
English - - -	—[1]	—[1]	—[1]	—[1]	—	1½	—	1¼	2¼	2	2¾	2½	2	3	2½	3½	4½	3½	2½	2½	2½
History and Geography	—[6]	—	—	—	—	1	—	—	—	1	1	1	1½	1	1¼	1	1	1¼	1½	1½	1½
Mathematics and Arithmetic.	2¼	9¾	4	6	6	6½	6	6	6	6	6	6	6½	6½	6½	6½	6½	9¾	9¾	9¾	9¾
Physics - - -	—	4½	5¼	1½	3½	4½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chemistry - - -	—	—	6¾[7]	6¾	5¼	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Drawing and Writing -	—	4½	2¾	5	4½	3	—	2	2¾	4	3¼	3¾	3½	4½	4½	4½	5½	4½	3	2¾	5½
Total - -	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼	26¼

[1] In the highest forms the voluntary study of English is encouraged by the yearly award of two "Shakespeare Scholarships," and the Early English Text Society's prize.

[2] The teaching of History and Geography is an essential part of the classical teaching.

[3] In all forms below the VIth a map is drawn each month as home work.

[4] In all forms below the Vth the time given to languages is exclusive of the time spent on looking over exercises.

[5] In the Mathematical VIth, Science VIth, Science Transitus, Science Vth, and Science Remove, the study of Modern Languages is alternative with that of the Classics.

[6] In the Classical VIth, Classical Transitus, and Modern Language Remove, the time devoted to Modern Languages is equally divided between French and German.

[7] The Science VIth and Science Transitus receive instruction in Practical Chemistry four hours per week, exclusive of the usual school hours.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science Classes:—

	Average Age.	No. of Boys.
Mathematical Sixth - -	17½	15
Science Sixth - - -	16½	20
Science Transitus - -	15½	30
Science Fifth - - -	15	30
Science Remove - -	14	40

Question 6. Amount of knowledge required before the study of Science is commenced.—Those boys who show an aptitude for Mathematics are specially urged to enter the Science forms. None would be permitted to enter them (except under special circumstances) who have not reached the Fourth form.

Question 7. Is any alternative or choice of subjects offered?

What departments of Science are preferred?

(*a*.) By parents?

(*b*.) By the boys?

In the Science forms the scientific subjects are fixed; as I have said before, there are voluntary classes for Chemistry, Mechanics, and Physical Geography, any, or all of which a boy may attend at his pleasure.

(*a*.) There are several boys in the school whom their parents destine to become manufacturing chemists; in the case of some of these the wish has been expressed that special attention should be given to their Chemical studies.

(*b*.) Electricity and Chemistry.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—Physics and Chemistry receive an equal degree of care. Beginners seem to derive most profit from Acoustics, and the more advanced students from Optics and Chemistry; Electricity and Heat occupying an intermediate position.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—A boy's position in the Science forms and his prospects of promotion depend almost entirely on his scientific attainments. As I have explained in answer to Question 1, the Science and Mathematical forms are regarded as equal to the highest classical forms.

NOTE.—The answers signed "J. A." are written by Mr. Angell, the teacher of Physics at the Grammar School.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a*.) Oral teaching and demonstration?

(*b*.) Book work?

(*c*.) Practical work?

(*a*.) The whole of the time occupied in the class is given (with very few exceptions) to oral teaching and experimental demonstration. "J. A."

(*b*.) Text-books are used only in the preparation of home work, excepting only where they are used in the absence of the necessary large diagrams or special apparatus, which may be well figured in the text book. "J. A."

(*c*.) A very few only of the upper boys in the Sixth Science form do any systematic practical work, because of the want of a physical laboratory (a great defect). The boys are, however, often called down during an ordinary lesson and required (before the class) to arrange apparatus for a particular demonstration, or to perform an experiment. "J. A."

In the Chemical lessons practical work in the laboratory occupies twice as much time as oral teaching.

Question 11. Which form of lesson is found to be most effective?—I find the "Socratic" form of lesson the most efficient. In this form of lesson the information required to be taught is either educed or built up by series of logical questions systematically put to the boys, not on what they have acquired verbally from the book or the teachers, but put to them on the apparatus, the experiment, or the phenomena, or problems as they are actually before them. In this way the observing and reasoning processes, and those of scientific literary exposition are cultivated simultaneously. "J. A."

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Text-books are mainly used for the purpose of recapitulation and revision, the book work is used as supplementary to the oral lesson, that is, not so much for the purpose of communicating information as for supplying a literary model of connected scientific exposition. "J. A."

Question 13. Is the use of note-books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—

(*a*.) Note books are used during the lesson, but only for the briefest possible notes, rather heads of subjects, apparatus, experiments, etc., than notes proper. But they are chiefly used after the lesson for making fuller home notes, in which case the boys are also encouraged to use the text-book as an auxiliary. In the "Socratic" form of lesson the work of the lesson itself keeps the teacher fully informed of the progress and attainments of his class. "J. A."

My own experience has shown me that, in scientific teaching, where mere memory is the least important active faculty, but where the activity of the observing, reasoning, constructive, and investigating powers is continuously required, the mental condition essential to the taking of full notes is inconsistent with the real scientific progress which should be made during the course of any really well-reasoned out and demonstrated scientific lesson: the notes made after the lesson cannot, however, be too full or complete. "J. A."

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Boys are often required to construct at home, in the place of their ordinary home lessons, special pieces of apparatus, as—a polariscope, selenite figures for the same, an electrophorus, induction coil, diffraction apparatus, models of Nicol's prisms, electrotype apparatus, voltaic batteries, &c. Unfortunately, however, we have no proper physical laboratory. "J. A."

The chemistry lecture room can accommodate easily 80 boys. The chemical laboratory accommodates 84 boys, each of whom is provided with a cupboard, and drawer, and set of chemical re-agents; each boy is told at the beginning of the lesson what his work for the day is, and how to do it; he is then left to perform the experiments, and must do so to the satisfaction of the master. When sufficiently advanced, he is given a solution or substance to analyse.

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school?—The "Socratic" method. (See 11.) "J. A."

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?—(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

We have—

1. A chemical laboratory and lecture room, balance room, and preparation room.
2. A physical lecture room with preparation room attached.

Tracings of these rooms are sent herewith.

Question 17. Number of assistants and curators, and annual cost?—For physics, Mr. Angell and pupil assistant; for chemistry, Mr. Jones and assistant. Gross cost 650*l.* a year.

To this should be added the cost of teaching experimental mechanics, on which one of the mathematical masters spends no small part of his time.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—Our most valuable and useful set of apparatus is our oxyhydrogen lantern, microscope and polariscopes (reflecting and refracting). "J. A."

The annual cost seems to be about 100*l.* There is no fixed sum allowed yearly, but grants are made by the Trustees from time to time at their discretion.

List of Apparatus and Cost.

	£	*s.*	*d.*
One Five-cell Grove Battery, quart size	5	0	0
Parallelogram and Forces apparatus	6	15	0
Three sets of Pulleys, to order	6	10	0
Pneumatic apparatus, Air Pump, Mercurial Gauge, &c., complete	18	10	0
One Attwood's Machine, complete	14	0	0
Marcel's Steam Apparatus	4	4	0
Pocket Spectroscope and case	4	7	6
Five Grove's Cells Battery	4	10	0
Model of Kater's Pendulum	3	3	0
Double Syren Organ and Bellows	16	10	0
Vibrating Prism	2	0	0
Wheatstone's Photometer	2	0	0
Gamut of Bells	1	10	0
Line Thermo Pile	2	15	0
Galvanometer	4	4	0
Monochord	5	5	0
Egg-shaped Vessel	2	5	0
Battery, Leyden Jars	5	0	0
Oxyhydrogen Lantern, complete	37	10	0
Polariscope	7	0	0
Coulomb Torsion Balance	4	10	0
Tangen's Galvanometer	6	10	0
Wheatstone's Bridge	3	10	0
Double Syren	12	0	0
Electric Lamp	10	10	0
Biott's Apparatus	2	2	0
Hot Air Bath and Regulator	3	0	0
Blow Pipe Table	4	4	0
Pair of Gas Holders	18	0	0
One No. 6 Balance and case, to order, complete	16	12	6
Set of Weights to 500 grammes	3	3	0
One No. 3 Balance, agate edges, to order, complete	12	1	6
Sets of Mahogany Cubes	10	0	0
Retort Stands, &c.	20	0	0
Model of Force Pump	1	15	0
Model of Lift Pump	1	5	0
Metronome	2	2	0
Pair of Reflectors	3	15	0
Electro Magnet	1	10	0
	£289	8	6

This list contains only the principal scientific apparatus in use at the Grammar School; the numerous smaller and less important articles have been omitted from the foregoing list.

Question 19. Is there a workshop? and if so, how, and for what particular purpose is it used?—We have unfortunately no workshop. "J. A."

Question 20. What text-books are in use, distinguishing between those for the junior and senior classes?—Text-book, "Chemistry," *seniors*, Roscoe's Chemistry, Bloxam's Metallurgy, Fownes' Chemistry; *juniors*, Roscoe's Chemistry.

Our text-book for *juniors* is, "Lessons on Elementary Physics" by Balfour Stewart, but we probably next year may find a better illustrated work, one with a greater number of experiments, and pictures of apparatus.

The text-book for our *seniors* is, "Ganot's Physics" by Atkinson, many of the boys also use Balfour Stewart's "Treatise on Heat," also "Deschanel's Natural Philosophy," by Everett. "J. A."

Question 21. To what books of reference, other than ordinary school books, have the scholars access?

(*a.*) The boys' Philosophical Society has formed a small science library of its own, which within the last month or two has been augmented by the liberality of a friend.

(*b.*) Watts' Dictionary of Chemistry, Miller's Chemistry, Tyndall on Sound, Heat, Diamagnetism, Humboldt's Cosmos, Roscoe's Spectrum Analysis, Lyell's Geology, Carpenter's Physiology, Darwin's Descent of Man, Ansted's Physical Geography, etc. etc.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—Yes, "The Manchester Grammar School Philosophical Society," established in 1869.

It is composed of the boys of the sixth and other science forms, its officers are elected from among its members by ballot, it meets every Friday after school for the reading and discussion of scientific papers, written by its members, the subscription is 2*s.* entrance fee, and 2*s.* 6*d.* per term. There are three terms per annum. The society is decidedly useful in promoting scientific reading and thought among the members. "J. A."

Tests of Progress.

Question 23. How often is the work tested?—Progress is tested during each lesson (see Q. 11).

Special class examinations are also made about twice each term, note books are also examined. Progress is also tested by independent examiners, that is, by the ordinary yearly science examinations held each May by the Department of Science and Art (Professor Tyndall, examiner).

And by examinations conducted annually in July by an independent examiner sent from the University of Oxford. This year the examiner was Professor Chapman. "J. A."

Question 24. In what way? *e.g.*, by examination of note books, or by oral or written questions?—The independent examiners conduct their examinations by means of printed papers. Our own examinations also include that of note books. "J. A."

Question 25. By whom? by the teachers of the subjects or by an independent examiner?—In May by the Department of Science and Art at their ordinary annual science examination.

At the end of July by an examiner from Oxford or Cambridge. Our last three examiners have been Mr. Esson of Merton College, Mr. Vernon Harcourt of Christ Church, and Mr. Chapman of Magdalen College, Oxford.

At Christmas by a general examination, by means of written papers, by the teachers of the subjects. "J. A."

Teachers.

Question 26. Is there any difficulty in procuring competent Science masters?—I have been concerned in the appointment of three science masters, and on each occasion there were several eligible candidates. The three gentlemen who were selected had each received a different kind of training, but had all proved themselves successful teachers.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—See answer to preceding question.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—Success as a teacher is the qualification upon which I should lay most stress.

Question 29. Can you state any results of science teaching in the school? such as—

(*a*.) Success, professional or otherwise, of individual scholars.

(*b*.) Influence upon the general studies and intellectual life of the school?

(*a*.) Ten or 12 boys from the school have taken Science scholarships at the University of Oxford, and a few have passed the first B.Sc. at the University of London, but we must not expect to see the tangible results of our science teaching for some years to come.

(*b*.) Since the introduction of the science teaching and the connected changes in our system the number of our boys has largely increased. By the side of the old classical forms, which remain at least as strong as before, there have grown up science and mathematical forms, training, for a life of study and an University career, boys who earlier would with difficulty have found a place for their special aptitudes. The number of prizes and certificates from South Kensington show that an influence for good has been at work upon the younger boys, and to name the result which (to the schoolmaster) is, perhaps, the most important of all, the number of utterly listless boys between 15 and 18, who seem incapable of being roused to take an interest in anything, has almost disappeared.

Question 30. Are any special rewards or encouragements (*e.g.*, exhibitions, scholarships, or prizes) open to successful students of science in the School?—There are two Science exhibitions (lately founded by Miss Brackenbury) worth about 45*l*. a year each, tenable for three years at the University of Oxford, consequently there is a Science exhibition awarded two years out of three.

The Scienceforms take their full share of the general prizes of the school.

Question 31. What improvements do you think could be effected in the teaching of Science in your own school?—I believe an observatory, a physical laboratory, and a boy's workshop would be of great service, but what we most need is an increase in the teaching staff.

Question 32. What are the principal obstacles to the teaching of science in your own school?—The boys in the classical forms are fully tasked, I think overtasked, by their present work, so that under existing conditions they cannot be taught Science with any good results; many boys, however, are detained by their parents in the classical forms, who mentally would profit far more in a Science form, but this generally is done for the sufficient reason that a literary training is of vital importance to the boy's prospects in life.

Question 33. How could the Universities best assist science-teaching in schools?—The University of Oxford has done much towards the introduction of Science into school teaching; indeed, I have often been surprised by the ignorance men of science show at the vigorous efforts made in this direction, both by the University and the Department of Science and Art. Much additional good would be done if the Universities instituted a general matriculation or leaving examination, comprising:—

(1) Mathematics, (2) Science, (3) Language and Literature, and allowing excellence in one subject to compensate for defects in another. School teaching ought to lay in the minds of the young a broad and a common basis for subsequent and more special culture. Many hindrances have hitherto lain in the way. A fear of superficial knowledge, the immediate demands of practical life, various competitive examinations, but chiefly the want of agreement as to the subjects to be taught: this last and principal obstacle is fast disappearing, and if the State and the Universities gave the schoolmaster their assistance we should soon see a more comprehensive and harmonious system of instruction introduced.

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?—Nothing in my judgment would be so beneficial to endowed schools as systematic inspection and subordination to some central authority. Whatever assistance scientific studies would receive from such a change, and it would be great, Classics, Mathematics, and Modern Languages, would receive hardly less.

FREDK. W. WALKER, M.A.,
High Master,
(p. S. H. H.)

December 26, 1872.

---

18. HARROW SCHOOL.

General Arrangements.

Question 1. How is the school classified?—The School consists of two Sides: (1.) The Classical Side; and (2.) The Modern Side (which was established in September 1869). The Forms during the present Term are as follow:—

The Classical Side.

The Monitors and VI. 1		35 boys.
VI. 2		31 „
First Vth		35 „
Second Vth		32 „
Third V.		33 „
Upper Remove		33 „
Lower Remove	α 34	63 „
„ „	β 29	
Upper Shell	α 32	65 „
„ „	β 33	
Middle Shell	α 32	63 „
„ „	β 31	
Lower Shell		33 „
First IVth		33 „
Second IV.		32 „
Third IV.		17 „

(2.) The Modern Side (which was established in September 1869).

The Modern Side.

VIth	6 boys.
Upper Vth	9 „
Lower Vth	12 „
Modern Remove	10 „
Upper Shell	11 „
Lower Shell	4 „

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?—Natural Science is taught to all boys on the Modern side, and to boys in the Vth forms and Upper Remove on the Classical side.

Question 3. Copy of time table?

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes?—The Modern side have been taught in two divisions, each consisting of about 26. In future they will be divided into three divisions. The boys on the Classical side are at present taught in four divisions, each consisting of about 33 boys.

Question 6. Amount of knowledge required before the study of Science is commenced?—No boy is at present allowed to join the Modern side unless he has been one year in school, and is at least in the Lower Shell.

Question 7. Is any alternative or choice of subjects offered?

What departments of Science are preferred?

a. By parents?

b. By the boys?

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—Experimental physics is the only subject which has been taught in school. A few boys receive instruction in comparative anatomy and physiology during the half holidays, and other times which they can arrange with the teacher.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—The same weight as to other subjects, the proportions being determined by the time given to the several subjects.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a*.) Oral teaching and demonstration?—The boys on the Classical Side are present at one lecture a week. The boys on the Modern Side are present at two lectures in each week. All the boys are required to take notes of the lectures, which are examined by the teacher.

(*b.*) Book work?—The boys who are in the Upper Division of the Modern Side are recommended to read a text-book out of school.

(*c.*) Practical work? — Practical work is attempted only with the Upper Division of the Modern Side one hour in the week. As soon as the new lecture rooms and laboratories are erected, it is expected that practical work in physics and chemistry will be found to be the most efficient means of teaching these subjects.

Question 11. Which form of lesson is found to be most effective?—As far as it has been attempted, a lesson in which the boys are made to repeat experiments which they have seen performed by the teacher at a previous lesson, or other simple experiments, is found to be by far the most effective.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—At present text-books are used in a few cases only, as stated in the answer to Q. 10.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—The boys are recommended to take brief notes during the lesson, and afterwards to write these out at length, making careful drawings of apparatus, &c.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons? — In the summer, prizes are offered by the School Scientific Society for the best collections of plants, moths, butterflies, &c.

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school?—Comparative anatomy has been taught to a few boys, with some success, by making them read Professor Huxley's Physiology, as an introduction to the subject. The teacher gives one or two elementary lectures on the subject of each chapter *before* it is read. The tissues are examined and carefully drawn. Comparative Osteology is then commenced. Specimens of every important order are examined and made out with the teacher's help, or by reference to such books as Professor Flower's Osteology of the Mammalia. Specimens of dissected animals are then examined, and dissections of all the classes of animals are made.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

It is intended that the following rooms should be erected in 1873:—

One lecture room for physics, capable of holding 75 boys.

One laboratory for physics, capable of holding about 20 boys at work.

One apparatus room, and a small sitting room, for physics.

One lecture room for chemistry, capable of holding 75 boys.

One laboratory for chemistry, capable of holding 25 boys.

These buildings will cost 4,800*l.*, exclusive of fittings.

It is also proposed at a future time to add a preparation room and a balance room for the chemical department. It is also proposed to have a room for typical specimens (illustrative of Botany, Zoology, Geology, and Mineralogy), and for practical work in comparative anatomy.

Question 17. Number of assistants and curators, and annual cost?—At present there is only one master. When the chemical lecture room, &c., referred to above, are ready, another master will be appointed.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—Large workshops will be erected during the course of 1873.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There is a good school library to which all boys have access during certain hours.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—Yes. The rules of the society are appended. Meetings are held about once a fortnight. Papers are read by the members, or, occasionally, by strangers. It is almost impossible to estimate its influence on the boys generally. The members themselves undoubtedly receive benefit from the papers, and the discussions which follow. The society also exercises good influence on those who make botanical and other collections.

Tests of Progress.

Question 23. How often is the work tested?—Once in each term. (Three times a year.)

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—By examination of note books once a week, or oftener; and by written questions at the end of each term.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—The examinations referred to above are at present held by the teacher; but, once a year, there is an examination in the work of the year for two prizes given by the Head Master. This is conducted by an independent examiner (generally from Oxford or Cambridge).

Teachers.

Question 26. Is there any difficulty in procuring competent Science masters?

Question 27. Where are the best obtained? Have they been specially trained for the work? and if so, in what does such training consist?

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of Science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?—Two prizes are given annually by the Head Master.

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own school?—At present all the teaching of Natural Science is carried on in a room which is used during certain hours of the day by one of the classical masters. As soon as the new rooms are finished, it is hoped that the teaching will be much more effective. No practical work, worthy of the name, is now attempted, except with a few boys, and without practical work no real progress seems to be possible, except in the case of boys of unusual ability.

Question 32. What are the principal obstacles to the teaching of Science in your own school?—Vide answer to question 31.

Question 33. How could the Universities best assist science-teaching in schools?—Probably by increasing the number of scholarships, and by making some branch of experimental physics or chemistry a necessary part of the first examination that is passed by every undergraduate.

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?—If "Leaving Examinations" were established, increased attention would necessarily be given to Natural Science at schools, if some branch of the subject were made compulsory in these examinations, whether conducted by the Government or by the Universities.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

H. Montagu Butler, D.D.,
Head Master.

January 23, 1873.

---

19. Eton College.

Answers by Rev. Dr. Hornby.

General Arrangements.

Question 1. How is the school classified?—The nominal forms are the 6th (the highest), the 5th, the Remove, the 4th, and the 3rd; but these forms are, in some cases, very large, *e.g.*, the 5th contains about 480 boys. The 6th and 5th forms together are, therefore, split up into 14 divisions, each under a different classical master. These divisions are arranged in groups, called A. B. C. D.

The A group comprises divisions - - 1, 2, 3.
B „ „ „ - 4, 5, 6.
C „ „ „ - 7, 8, 9, 10.
D „ „ „ - 11, 12, 13, 14.

For mathematics and science (and in some cases for French), the different groups are divided afresh, on a different principle, among the mathematical staff (or the French staff).

A whole group, *e.g.* B. or C., goes to mathematics together, and the mathematical masters arrange them, according to their mathematical proficiency, in different classes. Ten mathematical classes can go on simultaneously.

A similar redistribution, but not so complete, is made for science teaching: see Mr. Madan's answer to question 31.

The Remove and 4th form are similarly arranged, but they have no science teaching.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Science is taught as a necessary part of the school course from division IV. to IX. inclusive.

It is an alternative subject with modern languages, modern history, extra classics, or extra mathematics, in divisions I., II., III.

Question 3. Copy of Time Table.

Woolwich Divisions—Lent School-Time, 1873.

B.

Day of the Week.	7.30.	9.45.	11.15.	3.	5.15.
Monday	Greek Testament		Mathematics	Mathematics	Mathematics.
Tuesday	French	Political Geography	Mathematics		—
Wednesday	Version		Mathematics	Latin Construing	Latin Construing.
Thursday	French	Mathematics	Political Geography	—	—
Friday	Mathematics		Mathematics	Latin Construing	Mathematics.
Saturday	Version	Latin Coustruing	Mathematics	—	—

1 Divinity, 6 Latin, 2 French, 2 Political Geography, 11 Mathematics.

C.

Day of the Week.	7.30.	9.45.	11.15.	3.	5.15.
Monday	Greek Testament		Mathematics	Geography	Mathematics.
Tuesday	French	Political Geography	Mathematics	—	—
Wednesday	Mathematics		Latin Construing	Mathematics	Latin Construing.
Thursday	French	Mathematics	Political Geography	—	—
Friday	Version		Latin Construing	Mathematics	Latin Construing.
Saturday	Translation	Mathematics	Mathematics	—	—

1 Divinity, 6 Latin, 1 Geography, 2 Political Geography, 2 French, 10 Mathematics.

D.

Day of the Week.	7.30.	9.45.	11.15.	3.	5.15.
Monday	Greek Testament		Mathematics	Mathematics	Geography.
Tuesday	Mathematics	Political Geography	Mathematics	—	—
Wednesday	Mathematics		Latin Construing	Mathematics	French.
Thursday	Mathematics	Latin Construing	Political Geography	—	
Friday	Latin Composition		Latin Construing	Latin Construing	French.
Saturday	Saying Lesson	Mathematics	Mathematics	—	—

Divinity, 5 Latin, 1 Saying, 1 Geography, 2 Political Geography, 2 French, 10 Mathematics.

A Boy in the Woolwich Class, if in his last year, will have three lessons a week in English History and Literature: two of these lessons will be at hours in which he would not otherwise be in School; the remaining one will be at the Mathematical hour.

A. (Divisions I., II., III.)

TIME.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
7.30	Greek Testament	Construe Latin Poetry.	Composition in School. Latin.	Saying Lesson -	Construe Greek Poetry.	Version. Translation.
9.45	Mathematics -	- - -	- - -	New Studies -	- - -	New Studies.
11.15	Construe Greek Prose.	Construe Greek Prose.	Construe Greek Poetry.	Construe Greek Prose.	Mathematics -	Construe Latin Poetry.
3.0	Saying Lesson -	- - -	New Studies -	- - -	New Studies -	—
5.15	Construe Latin Prose.	- - -	5. Mathematics -	- - -	Construe Latin Prose.	

B. (Divisions IV., V., VI.)

7.30	Greek Testament	French - -	Version - -	French - -	Mathematics -	Translation. Version.
9.45	- - -	Saying Lesson -	- - -	Saying Lesson. Show up French Exercise.	- - -	Construe Latin Poetry.
11.15	Mathematics -	Physical Science	Mathematics -	Construe Greek Poetry.	Construe Greek Poetry. Shew up Verses.	Theocritus. —
3.0	Construe Greek Prose.	- - -	Construe Latin Prose.	- - -	Construe Latin Poetry.	—
5.15	Construe Greek Prose.	- - -	Construe Latin Prose.	- - -	Physical Science -	—

C. (Divisions VII., VIII., IX., X.)

7.30	Greek Testament	French - -	Mathematics -	French - -	Version - -	Translation.
9.45	- - -	Saying Lesson -	- - -	Physical Science	- - -	Physical Science.
11.15	Construe Greek Prose.	Construe Greek Prose.	Construe Latin Prose.	Construe Greek Poetry.	Construe Latin Poetry.	Construe Greek Poetry.
3.0	Geography -	- - -	Saying Lesson -	- - -	Mathematics.	—
5.15	5. Mathematics -	- - -	Construe Latin Prose.	- - -	Construe Latin Poetry.	—

D. (Divisions XI., XII., XIII., XIV.)

7.30	Greek Testament	Mathematics -	Saying Lesson -	Mathematics -	Latin Composition in School.	Saying Lesson.
9.45	- - -	Greek Exercise -	- - -	Construe Latin Prose.	- - -	Construe Greek Poetry.
11.15	Construe Greek Prose.	Construe Greek Prose.	Construe Latin Prose.	Construe Greek Poetry.	Construe Latin Poetry.	Mathematics.
3.0	Mathematics -	- - -	Mathematics -	- - -	Construe Latin Poetry.	—
5.15	Geography -	- - -	French -	- - -	French.	—

The accompanying Scheme shows the arrangement of lessons for the first 14 school divisions, *i.e.*, for the whole of the Sixth and Fifth Forms. The time table of the Lower boys is not given, as it is not proposed to admit any of them into the army class.

Boys who join the army class can commute Greek for additional Mathematics and English, giving up five lessons in the week, and taking six, thus getting 22 lessons in the week as against 21 in the ordinary Classical course.

The proportion of studies in this Scheme is as follows:—

In the A. Divisions—1 Lesson Divinity, 8 Latin, 6 Mathematics, 3 English History and Literature, 4 New Studies, *i.e.* French or German, or Italian or Geography, or Physical Science. Total—22.

In the B. C. D. Divisions—1 Lesson Divinity, 7 Latin, 6 Mathematics, 3 English, 2 French, 2 Physical Science, 1 Greek. Total—22.

Woolwich Divisions,
Feb. 5th 1873.

J. J. HORNBY.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

A. Divisions - 1 hour Divinity.
" - 3 Mathematics.
" - 4 Alternative Subjects, Science, History, &c., &c.
" - 13 Classics.
B. " - 1 hour Divinity.
" - 3 Mathematics.
" - 2 Science.
" - 2 French.
" - 13 Classics.
C. " - The same, except that there is *e.g.* geography lesson in place of one of the classical lessons.
D. " - The same, as C., except that there is no Science, but five mathematical lessons instead of three.

Exercises are done out of school; and other work, *e.g.* extra divinity, classics, English, &c., &c., are done with the tutors in their houses. This is known as private business.

There is also voluntary work in the laboratory during play hours: see Mr. Madan's answers.

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes.

See Mr. Madan's answer for his own classes; other boys are learning physical geography, or elementary astronomy, or mechanics in the Science hours. See Mr. Dalton's answer.

Their ages range from 18 to 13.

Question 6. Amount of knowledge required before the study of Science is commenced.

Sufficient knowledge of classics and mathematics to get into the Lower Fifth form. This may be done by average boys of 13 or 14 years of age.

The examination for admission to the 5th form includes translation from such books as Homer, Virgil, Xenophon, Cæsar, Latin (prose and verse) composition, ancient history, French.

In Mathematics—
Arithmetic, all, except the higher rules, *e.g.* discount, profit and loss, stocks.
Algebra, to simultaneous equations (inclusive).
Euclid, first 12 propositions.

Question 7. Is any alternative or choice of subjects offered?

What departments of Science are preferred?
a. By parents?
b. By the boys?

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—In the "trials" for school promotion into the middle division of the 5th Form, and into the Upper division, *one* Science paper is set. The papers are 12 in all.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—
(*a.*) Oral teaching and demonstration?
(*b.*) Book work?
(*c.*) Practical work?

Question 11. Which form of lesson is found to be most effective?

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible accompany this return.)

Question 17. Number of assistants and curators, and annual cost.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?

Tests of Progress.

Question 23. How often is the work tested.

Question 24. In what way? *e.g.*, by examination of note books, or by oral or written questions?

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?

Teachers.

Question 26. Is there any difficulty in procuring competent Science masters?—I have hardly experience enough to answer this question, having only appointed one master, who was highly recommended by very competent persons, and has proved most able and efficient. But I think there is considerable difficulty in finding men of high scientific attainments who are also able and willing to teach boys.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?

Question 28. What evidence of scientific qualification rendered by candidates is found to be of most value?

Question 29. Can you state any results of Science teaching in the school? such as—
(*a.*) Success, professional or otherwise, of individual scholars.
(*b.*) Influence upon the general studies and intellectual life of the school.

Question 30. Are any special rewards or encouragement (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own school?

Question 32. What are the principal obstacles to the teaching of Science in your own school?

Question 33. How could the Universities best assist Science teaching in schools?

Question 34. Can you suggest any way in which Government could assist Science teaching in schools, as, for example, by inspection?

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

January 24, 1873.

ANSWERS by H. G. MADAN, Esq.

General Arrangements.

Question 1. How is the school classified?

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?

Question 3. Copy of Time Table.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes.

—	Optics.	Chemistry.	Hydrostatics.
Number of boys .. -	5	64	22
Average age - -	17–18	15–18	16

[The above refers to Mr. Madan's present classes.]

Question 6. Amount of knowledge required before the study of Science is commenced.

Question 7. Is any alternative or choice of subjects offered?—No alternative or choice of subjects is, as a rule, offered.

What departments of Science are preferred?
a. By parents?

Parents do not appear to have any decided preference for particular subjects, being simply desirous that their boys should be taught Natural Science. Chemistry is sometimes mentioned, but whether on rational grounds or not, is hardly clear.

b. By the boys?

Boys seem to take most interest in the subjects of "Heat" and "Chemistry of the non-metallic elements." The former subject, treated in a simple way, is undoubtedly very attractive to the younger boys.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—
(*a.*) Oral teaching and demonstration?

The work in school consists entirely of oral teaching and demonstration, the first 10 minutes, or more, being occupied in questions on the previous lesson.

(*b.*) Book work?
(*c.*) Practical work?

Practical work in the laboratory is done entirely out of school, the time devoted to it being from 3 to 3½ hours in each week. The time spent in regular school lessons is about one half of this.

Question 11. Which form of lesson is found to be most effective?—It is not quite easy to compare the oral instruction with the practical work. The latter is strictly supplementary to the former, and serves to fix in the mind what has been previously shown.

It is doubtful whether practical work by itself is sufficient. Without previous oral teaching a boy is apt to do an experiment mechanically, without realising its full meaning. During laboratory work the boys are advised to consult their text-books and note books, and constant reference is made to what has been shown in lecture.

Question 12. How are text-books used? *e.g.*, is book-work supplementary or preparatory to the oral lesson?—Text-books are considered as subsidiary and supplementary to oral lessons. The latter follow the general course of the text-book, and the boys are told to refer to their books, in writing out their notes of the lessons, for explanations and details beyond those which can be given in school hours.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—The use of note books is compulsory in all the classes.

In most cases the boys have to take rough notes during the lesson, and to show up once in each week an account or abstract of the two previous lessons, fairly written out in a larger book. These are looked over, corrected, and marked, the marks being read out in public.

In some of the lower classes the notes are written down, once for all, during the lessons, chiefly from dictation; many experiments, however, are left for the boys themselves to describe in their own words.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Boys are required to make and set up their own apparatus as far as possible.

Nothing is done for them which they seem able to do for themselves. In making gases, for example, the tubes are bent, corks fitted, substances weighed out, &c., by each boy for himself. Prizes are given each year for collections of butterflies made by the boys themselves during play hours.

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.), is made for Scientific Instruction, and how is it used?

(Plans and descriptions of these, with statements of their costs and annual expense, should, if possible, accompany this return.)

The laboratory buildings are shown in the annexed plan. Their total cost, inclusive of apparatus and fittings, was about 4,000*l.* The annual expenses cannot yet be accurately estimated, but will be about 80*l.* or 90*l.*, including coals, gas, insurance, rates, &c., but exclusive of servants' wages. There is one attendant at a salary of 1*l.* per week.

The work in the laboratory is voluntary, and done during play hours. When a boy has attended chemical lectures for a term, he is allowed to put his name down for laboratory work, and may, to a great extent, choose his own times for working. Each boy comes for a period of 1½ or 2 hours twice a week. A place at a work table is allotted to him, and all necessary materials and apparatus are supplied. As much personal supervision as possible is given, and a full account of every analysis made (and, in many cases, of other experiments) is written out and looked over by the teacher.

The observatory contains an equatorial telescope (with 6 in. object glass), with divided circles, driving clock, &c., a sidereal clock, together with a few necessary books and diagrams. Its total cost was about 600*l.*

It is under the management of a committee of masters who take it in turns to be in the observatory from 9.30 to 10.30 p.m.

The names of boys who are recommended by their masters are entered in a book, and four or five are taken up on every fine night, as well as occasionally during the day.

Question 17. Number of assistants and curators, and annual cost: see the answer to the previous question.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—The number of places fitted up in the laboratory, under its present arrangement, is 32. The number of names put down is never less than 30, and usually all the available places are occupied.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—There is a workshop connected with the laboratory, containing two lathes, work-bench, forge, and a fair supply of tools. It is chiefly used for preparing apparatus for lectures, but boys are encouraged to come there and taught to make things for themselves.

There are, besides this, two or three turners' shops in the town, to which many boys go.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

Chemistry
- Junior.—Wilson's Chemistry, Chambers's Course; Harcourt and Madan's Practical Chemistry.
- Senior.—Fownes' Chemistry; Fresenius's Qualitative Analysis.

Physics. Balfour Stewart's Elementary Physics; Ganot's Physics.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There is a good school library, containing many standard scientific works, *e.g.*, Watts' Dictionary of Chemistry.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—

Tests of Progress.

Question 23. How often is the work tested?—A part of each lesson is spent in putting questions on the previous lesson.

Note-books are looked over and marked once a week.

Two (or more) papers of questions are set in the course of the half.

There is an examination during the summer half conducted by independent examiners, in certain specified subjects, a list of which is published about a year previously.

Question 24. In what way? *e.g.* by examination of note books, or by oral or written questions?—Answered under previous question.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—Answered under previous question.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?—

Question 29. Can you state any results of science teaching in the school? such as—

(*a*.) Success, professional or otherwise, of individual scholars.

(*b*.) Influence upon the general studies and intellectual life of the school.

Science work has, no doubt, brought out some (but not many) boys who have previously shown no interest in, or power over, their school studies.

Generally speaking, however, the best boys in Classics are the best also in Natural Science.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of science in the school?—A prize of 10*l.* and another of 5*l.* are given upon the results of the annual examination alluded to under question 23.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—It would seem better to re-arrange the divisions for science work more completely than is now done. At present the boys (below the first hundred) are arranged mainly according to their classical or mathematical work; and there is some difficulty in organising a consecutive course of instruction for the boys.

A large room for a museum is also much wanted. There is a good nucleus for a geological collection, but no means of displaying it properly.

Question 32. What are the principal obstacles to the teaching of science in your own school?—The natural unwillingness of parents and tutors to allow boys to give up much time to a subject which has not hitherto had much influence on a boy's place in the school, and which does not often serve as an introduction to any recognised career or profession. This unwillingness is quite justifiable, as also is the objection made, that boys ought not to be taught too many subjects at once.

Question 33. How could the universities best assist Science teaching in schools?—By offering scholarships and prizes for Natural Science.

By giving increased facilities for the training of men as Science masters. Lectures might be given (as occasionally at South Kensington) on modes of teaching. This would indirectly assist in the numerous cases where boys are never intended to go to the University, but enter at once a profession, such as engineering or applied chemistry, where a knowledge of science is requisite.

Question 34. Can you suggest any way in which Government could assist Science teaching in schools, as, for example, by inspection?—By grants or loans of apparatus, diagrams, &c. (as is done in the case of Art schools).

By occasionally sending lecturers, who might also be inspectors.

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

Answers by Rev. T. Dalton.

General Arrangements.

Question 1. How is the school classified?

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?

Question 3. Copy of time table?

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes?

Divisions I.—III. - - - { 3 classes in Chemistry.
1 class in Physical Geography.

IVth division, Chemistry.

Divisions V.—XIV. formed until last schooltime - - { 6 classes in Physical Geography.
3 classes in Astronomy.
3 classes in Mechanics and Hydrostatics.
1 class in Heat.

Last schooltime.

Divisions V.—VIII. formed - { 2 classes in Physical Geography.
3 classes in Mechanics.

Divisions IX.—XIV. had no Physical Science.

In Divisions I.–III. there are 100 boys, whose ages vary (generally) from 17 to 19. They are allowed to choose two extra subjects out of about 10, and to each subject they give two hours a week. As I have said in my answer, three classes are formed in Chemistry, and one class in Physical Geography. The number of boys in each, last schooltime, was as follows:—

4 in 1st Chemistry class.
14 in 2nd „ „
8 in 3rd „ „
6 in Physical Geography class.

Division IV. consists of 34 boys, of ages varying generally from 16 to 18.

Divisions V.–XIV. have generally all the same number of boys,—in most terms, 33 each.

The 13 classes into which I have said they are divided for Science Teaching, are on the average of the same size, which gives (33×10) boys for 13 classes, or about 25 boys in each class. Their ages usually vary from 14 to 18, though occasionally a boy of 12 is so advanced as to have reached this part of the school.

Question 6. Amount of knowledge required before the study of science is commenced.

Question 7. Is any alternative or choice of subjects offered?—Only in divisions I.—III.

What departments of Science are preferred?

(*a.*) By parents?—Chemistry has attracted most interest; perhaps, owing to the perfect arrangements for it.

(*b.*) By the boys?—My experience is in favour of elementary astronomy; but probably teachers of other subjects could produce equally favourable instances.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?
(*b.*) Book work?
(*c.*) Practical work?

I can best answer this and the following questions together.

I have generally taught elementary astronomy for two consecutive schooltimes to the same class. The first schooltime no text book is used; I usually give a general explanation of the lesson, then I dictate a brief resumé of this explanation, which the boys take down in their note books: the next lesson is begun by a thorough examination, *vivâ voce*, of what was learnt the previous time; this probably occupies one-third of the time of the lesson, the remainder being used as before in explanation and dictation of the next part of the subject.

The second schooltime we use Mr. Lockyer's Astronomy. My method with this is to give a short explanatory account of what the lesson contains, and the next time to question thoroughly upon it.

One hour in about 7 or 8 is given to an examination paper.

In explaining, I, of course, make considerable use of the black-board.

I may add that, as far as my experience goes, rigorous oral questioning is most important, and is much more necessary in teaching Physical Science than other subjects.

Question 11. Which form of lesson is found to be most effective?

Question 12. How are text-books used? *e.g.*, is book work supplementary or preparatory to the oral lesson?

Question 13. Is the use of note books encouraged (*a*) during, or (*b*) after the lesson, and to what extent?—During the lesson. See answer to Q. 10.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Two prizes are given for the best collection of wild flowers and of insects. The boys collect for these during the schooltime.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden &c.) is made for Scientific Instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible accompany this return.)

I send with this a small photograph of the telescope. It was made by Cooke of York. It is of 6-inch aperture, and cost 350*l.* The observatory is on the top of a school tower, the expense of strengthening the tower by girders, and of the dome and fittings, &c., was between 250*l.* and 300*l.*

Question 17. Number of assistants and curators, and annual cost?

One assistant helps in the laboratory; part of his duty is to clean out the observatory, and look to the instrument.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

There is no fixed sum; the school fund bears the expense of keeping the observatory in order. It also pays for whatever is required at the laboratory beyond a payment of 10*s.* made by each boy who is making experiments.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?

Question 22. Is there any Scientific Society or Club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?

Tests of Progress.

Question 23. How often is the work tested?—Once in three or four weeks by a written examination. Three times a year by a paper on the work of the school time: also once a year by the examination (trials) for change of form.

Question 24. In what way? *e.g.* by examination of note books or by oral or written questions?—By written questions.

The note books are examined frequently during the schooltime.

Question 25. By whom? by the teachers of the subject, or by an independent examiner?

Teachers.

Question 26. Is there any difficulty in procuring competent Science masters?

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of Science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

The subject has hardly been introduced long enough to produce success at the Universities. I think it has had a beneficial result upon the school, both generally, and in the case of individuals. Almost all boys have had a certain amount of interest excited in them for this branch of knowledge: in several cases boys who have shown no aptitude for classics or mathematics have done extremely well in, and really worked at, Physical Science; but as a rule, boys who are good in classics or mathematics, are good also in Science.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own schools?

Question 32. What are the principal obstacles to the teaching of Science in your own school?

The whole tone of the school has, until lately, been so absolutely classical, that Science had to start with a certain amount of prejudice against it; this, I think, it has certainly overcome, it being now generally allowed that the subject has done good work for the boys. The rewards for success in classics are, however, so great that a boy must hesitate about endangering his progress in them, and it is difficult to reward him adequately for success in Science.

Question 33. How could the Universities best assist Science teaching in schools?

Question 34. Can you suggest any way in which Government could assist Science teaching in schools, as, for example, by inspection?

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

ANSWERS by REV. E. HALE.

General Arrangements.

Question 1. How is the school classified?

Question 2. Is Science a necessary part of the school course, or is it taught only in special forms or departments?

Question 3. Copy of Time Table.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes.

Question 6. Amount of knowledge required before the study of Science is commenced.

Question 7. Is any alternative or choice of subjects offered?—Yes.

What departments of Science are preferred?

a. By parents?—Parents require Science, but seem to have no preference.

b. By the boys?—I think physical geography and chemistry (when this latter is not taught in a large school division).

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—There are two sorts of classes in physical geography. One a small select class of boys who are older, the other divisions of 30 boys or more. In the former, text-books are used, but in the latter no text-book is used except a physical atlas.

(*b.*) Book work?—The teaching is oral; maps, diagrams, and photographs, and specimens of fossils (or prints) being used to exemplify the teaching. There are two lessons weekly. Each boy brings weekly an abstract of the two lessons. These abstracts are returned to them looked over and marked. After eight or 10 lessons an examination paper is set and carefully looked over and marked.

(*c.*) Practical work?—

Question 11. Which form of lesson is found to be most effective?—For a large class, oral teaching.

Question 12. How are text-books used? *e.g.*, is book work supplementary or preparatory to the oral lesson?—When text-books are used (as for the small select class mentioned), a portion of the text-book is explained, further illustrations are given, and before the next lesson the pupils bring an analysis of that portion which has been already explained to them.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—The use of note books during the lesson is encouraged. Some notes are dictated to the pupils, others are taken by the boys.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—Prizes are given for the best collections (systematically arranged) of wild flowers and insects.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school.

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

Question 17. Number of assistants and curators, and annual cost.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?—Keith Johnston's Physical Atlas for Schools (for all boys). In the small select class individual boys have used Mrs. Somerville's Physical Geography; Herschel's Physical Geography; Lyell's Elements and Principles; Tyndall on Heat.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—There is an excellent school library, to which the boys have access, and any books recommended by the science teachers are purchased for the library.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—A literary and scientific society, managed by the boys, and the members elected by them. The members read papers, and a discussion takes place. Occasionally lectures are given by persons not resident at Eton, by invitation of the Society.

Tests of Progress.

Question 23. How often is the work tested?—Yearly, a general examination is held for deciding places in the school, and a paper on the scientific work of the school for that year is set.

There are frequent class examinations, by printed papers, and every week the note-books or abstracts of lessons are looked over.

Question 24. In what way? *e.g.* by examination of note books or by oral or written questions?—As stated before, in both ways.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?

Teachers.

Question 26. Is there any difficulty in procuring competent Science masters?

Question 27. Where are they best obtained? Have they been specially trained for the work; and if so, in what does such training consist?

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of Science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars.

(*b.*) Influence upon the general studies and intellectual life of the school.

(*a.*) The time since which Science has been taught is too short to admit of any professional success, but of three candidates in 1872 for the medals of the Royal Geographical Society, two of the four medals were gained by them, and the other boy received honourable mention.

(*b.*) Intellectual activity is promoted, and habits of thought and observation are gained. Proofs of this are, that boys not remarkable for proficiency or the interest they take in their usual studies, are sometimes full of interest in learning science, and in rarer instances enthusiastic.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own school?—By a systematic division of subjects, allotting a certain course for certain school periods, and by making this course progressive.

I think, for efficient Science teaching, *every* boy should be taught Erd-kunde, in some such course as the following:—

(i.) The earth's position in the Solar system.
(ii.) The Atmosphere, Solar Heat (Rain, Snow, &c.).
(iii.) Very elementary Geology.
(iv.) Changes in the physical features of the Earth's Surface caused by Rain, Rivers, Ice, Snow, &c.
(v.) The Sea, Tides, Winds, Climate.
(vi.) Various divisions of animals and plants on the earth's surface, and their distribution.

After each boy has gone through a course of this, he should choose one of three divisions.

Div. (α) Astronomy, Mechanics, Hydrostatics, &c.; and a boy choosing this division should give extra time to mathematics.
Div. (β) Chemistry, Heat, Electricity, &c.
Div. (γ) Geology, Zoology, Botany, &c.

Question 32. What are the principal obstacles to the teaching of Science in your own school?

(i.) The divisions of the school being made with reference to the classical work only.
(ii.) The want of a museum and lecture-room.
(iii.) The belief among parents and masters that Science does not "pay," and is more play than work.

Question 33. How could the Universities best assist Science teaching in schools?—By offering better rewards to successful scientific men at the University, *e.g.*, by more Fellowships. (I refer more to Cambridge than to Oxford.)

Question 34. Can you suggest any way in which Government could assist Science teaching in schools, as, for example, by inspection?—By inspection, but not by examination.

Question 35. Have you any other information to give or suggestion to make, likely to be helpful to the Commissioners?

---

20. DULWICH COLLEGE.

(UPPER SCHOOL.)

General Arrangements.

Question 1. How is the school classified?—The school is divided into three sections (the junior section, the senior section, and the sixth form), within each of which an independent classification is made for each subject or group of subjects in which instruction is given.

The subjects of instruction are grouped as follows:—

In the junior section—

1. Form work, including English, Latin, and French.
2. Arithmetic.
3. Drawing.

In the senior section and sixth form—

1. Form work, including English, Latin, and French.
2. Mathematics.
3. Greek.
4. German.
5. Physical science.
6. Drawing.

Question 2. Is science a necessary part of the school course, or is it taught only in special forms or departments?—Instruction in science is open to all boys in the senior section and in the sixth form, but is not compulsory, except so far that all boys not learning Greek and the higher classics are required to take up at least one subject in science.

Question 3. Copy of time table?

GENERAL TIME TABLES.—SIXTH FORM, 1ST TERM, 1873.

	A. (1.)—CLASSICAL.		A. (2.)—MATHEMATICAL AND MODERN.	
Day.	Time.	Scheme.	Time.	Scheme.
MONDAY - -	9–11	Form Work.	9–11	Form Work.
	11–12.30	Mathematics.	11–12.30	Mathematics.
	2–2.30	Higher Classics.	2–3.30	Mathematics.
	3.30–4.30	French.	3.30–4.30	French.
TUESDAY - -	9–11	Form Work.	9–11	Form Work.
	11–12.30	Higher Classics.	11–12.30	Physical Science.
	2–3.15	Higher Classics (or German).	2–3.15	German.
	3.15–4.30	Higher Classics.	3.15–4.30	Mathematics.
WEDNESDAY -	9–11	Form Work.	9–11	Form Work.
	11–1	Special Classes.	11–1	Special Classes.
THURSDAY - -	9–10	Form Work.	9–10	Form Work.
	10–11	Mathematics.	10–11	Mathematics.
	11–12.30	Form Work.	11–12.30	Form Work.
	2–3.30	Higher Classics.	2–3.30	German.
	3.30–4.30	French.	3.30–4.30	French.
FRIDAY - -	9–10	Form Work.	9–10	Form Work.
	10–11.30	Higher Classics.	10–11.30	Mathematics.
	11.30–12.30	Form Work.	11.30–12.30	Form Work.
	2–3.15	Higher Classics (or German).	2–3.15	German or Mathematics.
	3.15–4.30	Higher Classics.	3.15–4.30	Mathematics.
SATURDAY - -	9–10.30	Form Work.	9–10.30	Form Work.
	10.30–11	Higher Classics.	10.30–11	Physical Science.
	11–1	Special Classes.	11–1	Special Classes.

NOTE.—Form work includes Latin, English, and Divinity.

Special Classes from 11 to 12 and 12 to 1. The choice is offered between Drawing, Greek, French, German, Physical Science, and Mathematics.

DETAILED TIME TABLES.—SIXTH FORM, 1ST TERM 1873.

Day.	CLASSICAL.		MATHEMATICAL AND MODERN.*	
	Time.	Scheme.	Time.	Scheme.
MONDAY - -	9–10	Grammar Paper (Latin or Greek).	9–10	Grammar Paper (Latin or German).
	10–11	Divinity.	10–11	Divinity.
	11–12.30	Mathematics.	11–12.30	Mathematics.
	2–3.30	Greek.	2–3.30	Mathematics.
	3.30–4.30	French.	3.30–4.40	French.
	Evening Work.	Greek Rep.	Evening Work.	Mathematics.
		Mathematics.		German.
		Latin Verse.		
TUESDAY - -	9	Greek Rep.		
	9.15–11	Latin.	9–11	Latin.
	11–12.30	Greek.	11–12.30	Physical Science.
	2–3.15	First-sight Trans. (or German).	2–3.15	German.
	3.15–4.30	Greek Prose.	3.15–4.30	Mathematics.
	Evening Work.	Latin with Rep.	Evening Work.	Latin with Rep.
		French.		French.
WEDNESDAY -	9	Latin Rep.	9	Latin Rep.
	9.15–10.30	Latin.	9.15–10.30	Latin.
	10.30–11	Correction of Paper Work in Class.	10.30–11	Correction of Paper Work Class.
	11–1	(Special Classes.)	11–1	(Special Classes.)
				Science.
				Mathematics.
	Evening Work.	History.	Evening Work.	History.
		Latin.		Latin.
		Latin Prose.		
THURSDAY - -	9–10	Latin.	9–10	Latin.
	10–11	Mathematics.	10–11	Mathematics.
	11–12.30	History.	11–12.30	History.
	2–3.30	Greek.	2–3.30	German or Mathematics.
	3.30–4.30	French.	3.30–4.30	French.
	Evening Work.	English Literature and Rep.	Evening Work.	English Literature and Rep.
		Latin.		Latin.
FRIDAY - -	9	English Rep.	9	English Rep.
	9.15–11	Latin.	9.15–10	Latin.
	10–11.30	Greek.	10–11.30	Mathematics.
	11.30–12.30	English Literature.	11.30–12.30	English Literature.
	2–3.15	Greek Prose (or German).	2–3.15	Mathematics.
	3 15–4.30	First-sight Translations.	3.15–4.30	German.
	Evening Work.	Greek with re-translation.	Evening Work.	Mathematics.
		French.		German.
		Greek Verse.		
SATURDAY - -	9–10.30	Latin.	9–10.30	Latin.
	10.30–11	Greek.	10.30–11	Physical Science.
	11–1	(Special Classes.)	11–1	(Special Classes.)
				Science.
				Mathematics.
	Evening Work.	Latin or Greek Grammar.	Evening Work.	Grammar (Latin or German).
		Divinity.		Divinity.
		(English Essay).		English Essay.

The English Essay is set on Saturday, and is delivered up on the following Saturday.

Essays and Classical Compositions are looked over with each boy separately during Preparation Time.

In the Special Classes a "Classical" boy will generally take up either Classics entirely, or Classics and German; but he has the option, under the usual restrictions, of any of the other Special Subjects.

In the Special Classes a "Mathematical" boy will generally take up Science and Mathematics; but he has the option, under the usual restrictions, of any of the other Special Subjects.

---

* *Science Students.*—On Wednesday afternoons (after ordinary school hours) a lesson is given in Analytical Chemistry, with practical work in the laboratory: 1 to 2 hours.

If a Science Student wishes to take up an additional subject, he can do so on Tuesday and Friday afternoons. In this case the necessary time (2½ hours for instruction, and 1½ hours for preparation) is obtained either by relinquishing German, or by reducing the time devoted to Mathematics.

GENERAL TIME TABLES.—SENIOR SECTION, 1ST TERM, 1873.

TABLE B.—SENIOR SECTION.

Day.	Time.	—
MONDAY - - -	9–12.30 2–3.15 3.15–4.30	Form Work. French. Form Work.
TUESDAY - -	9–11 11–12.30	Mathematics. Form Work.
	2–3.15 3.15–4.30 }	Greek { German. Physical Science.
WEDNESDAY - -	9–11 11–1	Form Work. (Special Classes.)
THURSDAY -	9–10	Form Work.
	10–11	Greek { German or Science.
	11–12.30 2–3.15 3.15–4.30	Mathematics. French. Form Work.
FRIDAY - - -	9–11 11–12.30	Mathematics. Form Work.
	2–3.15 3.15–4.30 }	Greek { German. Physical Science.
SATURDAY - -	9–11 11–1	Form Work. (Special Classes.)

Form work includes Latin, English, and Divinity (also writing in the Lower Forms).

Special Classes from 11 to 12 and from 12 to 1. The choice is offered between Drawing, Greek, French, German, Physical Science, and Mathematics.

* *Science Students.*—On Wednesday afternoons Laboratory Work as for the Sixth Form.

If a Science Student wishes to take up an additional subject he can do so during the time assigned to "Special Classes" on Wednesdays and Saturdays.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

TABLES indicating the distribution of time among the several Subjects of Study, with an estimate of the time spent n Evening Preparation.

SIXTH FORM.

Classical.	School Work Hours.	Evening Work Hours.	Hours.	Mathematical.	School Work Hours.	Evening Work Hours.	Hours.
English - - -	4¾	6½	11¼	English - - -	3¾	5	8¾
Latin - - -	7¾	7	14¾	Latin - - -	7¾	4	11¾
French - - -	2	1½	3½	French - - -	2	1½	3½
Mathematics - -	2½	1½	4	Mathematics, including Special Class - -	11½	5	16½
Greek and Higher Classics	11	3¾	14¾	German - - -	3	2½	½
				Science - - -	4	—	4
Special Classes— Either Classics or German - -	4	0	4				
	32	20¼*	52¼		32	18	50

* Evening Work includes a Divinity Lesson (presumed to be learnt on Sunday) and Composition.

	Science Students.—During School hours (as above) - - -	4 hours.
	After School hours - - -	2 „
		6
Do.	Additional Branch of Science - -	4
	Time available for Science Study -	10 hours.

SENIOR SECTION.—Distribution of time in one of the Forms of the Senior Section.

Classical.		School Work.	Evening Work.	—	Mathematical.	School Work.	Evening Work.	—
English		3½	8	11½	English	3	7	10
Latin		11	4¼	15¼	Latin	11	4¼	15¼
French		2½	2	4½	French	2½	2	4½
Mathematics		5½	1½	7	Mathematics	9½	2½	12
Greek	5½	—	—	—	German	2½	2	4½
Do. (Special)	2	7½	2	9½	Physical Science	3½	—	3½
One Special Class		2	—	2				
		32	17¾	49¾		32	17¾	49¾

Science Students.—During Schools hours (as above) - - - 3½ hours.
After School hours - - - - - - 2 „
5½ „
Do. Additional Branch of Science - - - 2 „
Time available for Science Study - 7½ „

Question 5. Summary of the number and average age of boys learning each of the various subjects in the Natural Science classes?

		Average age.
Chemistry, 1st class	21 boys.	15½
„ 2nd class	18 „	13¾
Practical chemistry, 1st class	9 „	15½
„ 2nd class	12 „	13½
Electricity and magnetism	32 „	14¼
Geology	35 „	14⅓
Physical geography	16 „	14¾

I have stated the actual average age, but the return in this respect is illusory, since the recent increase of the school (from 130 to 500 boys), and the excess in consequence of young boys lately admitted, reduces the average of age below its normal amount.

Question 6. Amount of knowledge required before the study of science is commenced?—Instruction in science is open to all boys in the senior section and in the sixth form.

Boys entering the senior section are presumed to have a fair elementary knowledge of English, French, Latin, and arithmetic.

Question 7. Is any alternative or choice of subjects offered?—The science subjects are grouped as follows:—

I. Chemistry, with laboratory work.
II. Physics (at present electricity and magnetism) } alternative subjects taught
Geology } at the same time by different masters.
III. Physical geography.

Boys have the opportunity of receiving instruction in one or more of these groups.

What departments of science are preferred?
a. By parents? } I have no sufficient data at present
b. By the boys? } for answering these questions.

Question 8. What branch of science receives most attention in the school, or is found by experience to have the greatest educational value?—A continuous course of instruction is given in chemistry.

Instruction is given from time to time in other branches of science—heat, electricity, magnetism, geology.

I am decidedly of opinion that chemistry possesses the greatest educational value.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—The classification for science is entirely independent. Prizes are awarded in each class at the annual examination. In the award of exhibitions 200 marks are assigned to science as against 220 to English, 220 to Latin, 150 to each modern language, 150 to elementary mathematics, and 300 to the higher mathematics.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?—Each of the classes receives two lectures per week of an hour or an hour and a quarter each.

(*b.*) Book work?—Book work is got up during the "preparation time," which, for the more advanced pupils, amounts to about two hours for chemistry and one hour and a half for physics.

(*c.*) Practical work?—One hour a week; for advanced pupils two hours.

A course of evening lectures (generally four or five lectures) on some branch of science is also given in each term. Attendance at these lectures is voluntary. They are open to all boys, whether pupils in any of the science classes or not.

Question 11. Which form of lesson is found to be most effective?—No one of them can be dispensed with, without impairing the efficiency of the entire system of instruction.

Question 12. How are text-books used? *e.g.*, Is book work supplementary or preparatory to the oral lesson?—Generally as supplementary to the oral instruction.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?—All boys are required to take notes at the lecture, and to get up the substance of their notes during preparation time in the intervals between the science lessons.

The note books are examined from time to time by the science master.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—At the practical chemistry class the boys prepare their own apparatus and experiments.

At the lectures the boys are told off in turn, one from each class, to assist the science master in preparing the apparatus and making the experiments.

Question 15. Describe any method of teaching some special branch of science which has been found successful in your school?

Instruments of Teaching.

Question 16. What special provision (*e.g.*, laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for scientific instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

(1.) A very complete laboratory, with all the most approved appliances, and capable of accommodating 36 students. To this is attached a smaller laboratory for a few more advanced pupils.

(2.) A lecture theatre, fitted with moveable desks for taking notes, and with pneumatic trough, Bunsen burners, and appliances for experimental purposes at the lecturer's table. The theatre will accommodate about 230 boys at the desks, and 300 when the desks are removed.

(3.) The formation of a museum of geology and natural history has been lately commenced.

The laboratory is used for practical work, under supervision of the instructor in chemistry, two hours per week.

The theatre for lectures on chemistry or physics four hours a week, and for the courses of evening lectures.

No plans are available.

The cost of construction being included in the general contract for the erection of the new buildings, is not on record, and could not, I fear, be estimated without much difficulty.

Question 17. Number of assistants and curators, and annual cost?

A teacher of chemistry, 120*l.* a year.

A teacher of physics (who is also a form master), part of salary apportioned to science, 80*l.* a year.

The services of the working engineer and of one or more of the college servants are employed in this department as required.

Separate payment is made for the evening lectures.

Question 18. What apparatus, diagrams, and special fittings are in use? what was their cost? and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—Apparatus, diagrams, &c. are being gradually provided. 75*l.* was expended in 1871 on the purchase of apparatus, and about 30*l.* last year.

There is no *fixed* sum appropriated for this purpose.

Question 19. Is there a workshop? and if so, how, and for what particular purpose, is it used?—Not at present.

Question 20. What text-books are in use? distinguishing between those for the junior and senior classes?

Chemistry:—
1st class—Miller's Inorganic Chemistry.
Gill's Chemistry for Schools.
Harcourt and Madan's Practical Chemistry.
Fresenius's Qualitative Analysis.

2nd class—Roscoe's Chemistry ("Science Primer").

Physics:—
Balfour Stewart's Elementary Physics.
Deschanel's Natural Philosophy.

Geology:—
1st class—Jukes's Student's Manual of Geology.
2nd class—Page's Introductory Text Book.
Jukes's School Manual of Geology.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—A few scientific books in the College library (to which the boys have access by special leave) and in the boys' school library.

Question 22. Is there any scientific society or club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—No.

Tests of Progress.

Question 23. How often is the work tested?—At the end of each term, and also by partial examinations two or three times during the course of the term.

Question 24. In what way? *e.g.*, by examination of note books or by oral or written questions?—At the terminal and general examinations by printed papers; at the intermediate examinations orally and by dictated papers.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—At the end of each term by one of the masters in the College not being the teacher of the class examined; and at the general examination of the school in June by an independent examiner; at the intermediate examinations by the teacher of the class.

Teachers.

Question 26. Is there any difficulty in procuring competent science masters?—There is at present some difficulty, but (I think) a decreasing one, in obtaining as science masters highly cultivated men who have received an university education.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—I have been able to obtain two well-qualified masters who have been educated at German universities, and one who has taken first-class honours in the science tripos at Cambridge.

Question 28. What evidence of scientific qualification tendered by candidates is found to be of most value?

Question 29. Can you state any results of science teaching in the school? such as—

(*a.*) Success, professional or otherwise, of individual scholars?

(*b.*) Influence upon the general studies and intellectual life of the school?

The science classes are of too recent formation to justify me in speaking definitely of the results.

With respect to the influence of science teaching upon the general studies and intellectual life of the school, I expressed my views in a statement which I had the honour to submit to the Commissioners in February 1871 (see p.). My subsequent experience has not led me in any way to modify the favourable opinion which I then entertained.

Question 30. Are any special rewards or encouragements (*e.g.*, exhibitions, scholarships, or prizes) open to successful students of science in the school?—Prizes are given for each branch of science and in every class. The marks obtained in the science examinations are combined in a fixed proportion with those for other subjects of study, to form the aggregate upon which the award of exhibitions is made.

Question 31. What improvements, do you think, could be effected in the teaching of science in your own school?—The system is now in process of development, and is receiving further extension and improvement every term.

Question 32. What are the principal obstacles to the teaching of science in your own school?

Question 33. How could the universities best assist science-teaching in schools?—Most effectually, I believe, by offering rewards to science students within the universities themselves.

If the proposed scheme of examination of schools by the universities is adopted, the science-teaching must of course be subjected to the same tests as the other subjects of study.

Question 34. Can you suggest any way in which Government could assist science-teaching in schools, as, for example, by inspection?

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

ALFRED J. CARVER,
Master of Dulwich College.

April 7th, 1873.

---

21. FRIENDS' BOYS' SCHOOL, YORK.

General Arrangements.

Question 1. How is the school classified?—Into four classes for the general English instruction. The language classes are to some extent distinct; for drawing, also, and partially for science, classes are occasionally thrown together, or the arrangements are modified.

Question 2. Is Science a necessary part of the school course, or is it only taught in special forms or departments—To some extent it is taught to all the boys.

Question 3. Copy of Time Table?—

SENIOR CLASS.

TIME.	MONDAY.	TUESDAY.	WEDNESDAY.	THURSDAY.	FRIDAY.	SATURDAY.
7–8 A.M.	French	Science	Mental Arithmetic.	Latin	French	Arithmetic.
$9–10\frac{1}{4}$	German	Greek	Writing	Latin	German	Latin.
$10\frac{1}{2}–11\frac{3}{4}$	French	Dictation and Writing.	Meeting for Divine Worship.	English	Physics or Arithmetic.	Greek.
12–1 P.M.	Mensuration	Drawing	Greek or Drill	Science	Drill, Mental Calculation.	Drawing.
$3–3\frac{3}{4}$	Euclid	History	- - -	History	Euclid	—
$3\frac{3}{4}–4\frac{1}{2}$	Algebra	Do.	- - -	Do.	Algebra	—
$4\frac{1}{2}–5$	Reading	Compound Addition.	- -	Compound Addition.	Reading	—
Evening Work.	*Lecture*	Prepare Greek (or Recitation).	Prepare Latin	Prepare German, and ditto $\frac{1}{2}$ hour's Arithmetic or Physics.	Prepare Latin and Greek.	Prepare French and German.

Second Division.

Time.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.
7–8 A.M.	German or Writing.	Latin - -	Mental Arithmetic.	Latin - -	German or Writing.	Prepare Latin.
9–10¼	French -	Greek - -	Writing -	Latin - -	French - -	Latin.
10½–11	Dictation -	Drawing -	Meeting for Divine Worship.	Writing and History.	Dictation -	Science.
11–11¾	Science -	Drawing -	- - -	History -	Arithmetic -	Spelling and Writing.
12–1 P.M.	Geography -	English Grammar.	Arithmetic and Drill.	Geography -	Drill and Mental Calculation.	History.
3–4¼	Mensuration -	Arithmetic -	- - -	Drawing and Reading.	Algebra - -	—
4¼–5	Reading -	Reading -	- - -	Euclid - -	Etymology -	—
Evening Work.	Prepare Greek and Latin, &c.	Prepare Greek -	Prepare Latin -	Prepare French and German, &c.	*Lecture* -	Prepare French, German, &c.

Question 4. Summary of hours per week given in each class to different subjects. (If playtime is utilized for preparation or practical work, this should be shown separately.)

In the Senior Class—

Latin - 3½ hours + 1½ hour (say) preparation.
Greek - 3½ „ + 1 „ „
French - 3¼ „ + ¾ „ „
German - 2½ „ + 1½ „ „
Arithmetic and Mensuration, 4; or for boys not taking the Theoretical Physics, 5¼.
Euclid, 1½.
Algebra, 1½, or, including the Physics, 2¾.
Writing, Spelling, &c., 2¼.
History, 3.
Science Lecture, 1¼; Classwork, 2; total 3¼.

Junior Class.—Few of these boys learn German, and none Greek; the time being mostly given to Arithmetic and Writing, approximately.

Latin 3¼ hours + 1½ preparation.
French 3½ „ + 1 „
English Grammar, 1½ hour.
Scripture, 1 hour (besides Sunday).
Arithmetic, 6 hours.
Writing and Spelling, 4¼ hours.
Reading, 2 hours.
Drawing, 2 hours.
Geography, 1½ + ¾ hour preparation.
History, ditto.
Science, 1¼ hour, lecture; 1½ hour, class.

The Second Division can be deduced from Table above.

The Third Division is nearly as the Junior Class.

Question 5. Summary of the number and average age of boys in the different Natural Science Classes learning each of the various subjects?

Senior class - 20 Average age - 15¼
Second „ - 21 „ „ - 14¼
Third „ - 15 „ „ - 13
Junior „ - 8 „ „ - 11¾

The subjects vary from year to year; the Senior Class are now taking Physiology and Optics; the Lower Class, Acoustics and Physiology. Chemistry forms a regular part of nearly every year's course.

Question 6. Amount of knowledge required before the study of Science is commenced?—No fixed line laid down.

Question 7. Is any alternative or choice of subjects offered?—Not in the regular lectures and lessons. A good deal of leisure time is often devoted by some of the boys, voluntarily, to different departments of Natural History (*e.g.* Botany, Entomology, &c.), or to Astronomy or Chemistry.

What departments of Science are preferred?

(*a.*) By parents?—Beyond incidental remarks, we have no means of judging as to this point.

(*b.*) By the boys?—Chemistry and Physiology; also, by a few of the elder boys, Astronomy.

Question 8. What branch of Science receives most attention in the school, or is found by experience to have the greatest educational value?—In different sessions our Science instruction is directed to different branches; but probably, on a general view, we might say that Chemistry, Mechanics, and Astronomy receive the largest share of attention, as direct school subjects, to which we must add Botany and Entomology for the pursuits of leisure time.

Question 9. What weight is assigned to scientific attainments in determining a boy's position in the school?—The Science classes rank on equal terms with those on any other subjects. A boy at the top of his class in the Science lessons for any month, takes as much advantage as if he were at the top of his Latin or French class, or his class in Arithmetic or Geography.

Methods of Teaching.

Question 10. What proportions of the lessons take the form respectively of—

(*a.*) Oral teaching and demonstration?
(*b.*) Book work?
(*c.*) Practical work?

One experimental lecture weekly to the Senior Class of about 20 boys; one ditto to the rest of the school (about 45 boys). The notes taken in these lectures are studied afterwards, and either the special Science teacher, or one of the regular class teachers, questions upon these in class. The boys have some elementary manual to refer to in preparing for these questionings. The *practical* work is *pretty much* confined to two or three elder boys, who assist in preparing for the lectures, except in regard to Astronomy, where the Observatory affords opportunity to a good many boys belonging to the Senior Class, to learn the use of instruments.

Question 11. What form of lesson is found to be most effective?—We think the combination described in answer 10 the best adapted to our circumstances.

Question 12. How are text-books used? *e.g.*, is book work supplementary or preparatory to the oral lesson?—Supplementary to the lectures; preparatory to the questioning.

Question 13. Is the use of note books encouraged (*a*) during or (*b*) after the lesson, and to what extent?

(*a.*) During the lecture the boys take as copious notes as may be, and these they are expected to study afterwards.

Only the Senior Class take notes in ink, the rest in pencil, copying them out afterwards under the direction of a teacher.

Question 14. How far are boys required to prepare their own apparatus or experiments, or to collect specimens during the intervals between lessons?—See answer 10.

The collection of Botanical, Conchological, Entomological, Geological, and other specimens, has long been encouraged as a pursuit for leisure time, and very successfully practised.

See reports of N. H. Society accompanying.

Question 15. Describe any method of teaching some special branch of Science which has been found successful in your school?

Instruments of Teaching.

Question 16. What special provision (*e.g.* laboratory, lecture room, observatory, museum, botanic garden, &c.) is made for Scientific Instruction, and how is it used?

(Plans and descriptions of these, with statements of their cost and annual expense, should, if possible, accompany this return.)

We have a lecture room, seating about 48 comfortably, with writing desk in front of the forms, much like the desks at University College, London. The room is rarely used for scientific lectures with *more* than about 40 at a time, but the whole school *can* be accommodated. A small laboratory adjoining is used by the Science teacher and any boys engaged in assisting him. The observatory, containing an equatorially-mounted refracting telescope of 4½-inch aperture, by Cooke of York, a small transit instrument, and sidereal clock, cost altogether about 250*l.* A room fitted up as a museum contains a portion of the specimens belonging to the school Natural History Society, embracing a large and valuable series of Geological and Mineralogical specimens, a herbarium, a collection of shells, insects, eggs, &c. We have also a number of mechanical models, working models of steam engines, and the like, some the property of the school, some belonging to one of the teachers, who has occasionally lectured on the steam engine and kindred subjects.

Question 17. Number of assistants and curators, and annual cost?

Question 18. What apparatus, diagrams, and special fittings are in use; what was their cost; and what sum is allowed yearly for new instruments, and to replace materials used, &c.?—See answer 16, *supra*:—The Science teacher has been accustomed to provide what he deemed needful, within moderate limits, for his lectures, and charge the amount to the school funds, any *special* outlay being first proposed to the superintendent for his sanction. The cost last year of the *lectures*, as to materials, wear and tear, breakage, &c., may be roughly estimated at 6*l.* 6*s.* to which should be added about 4*l.* for repairs of observatory instruments, and some connected with the workshop (refitting of part of a lathe).

The apparatus, diagrams, &c., have accumulated through a long series of years, and it would be difficult to give an estimate as to cost.

Question 19. Is there a workshop, and, if so, how and for what particular purpose is it used?—There is a workshop, much used by some of the boys in their leisure time. It is provided with two lathes, a fret saw machine, carpenter's bench, and suitable tools. A small subscription from the boys meets current expenses, with occasional grants from the school funds for any special outlay required. Usually at the end of a session, when an exhibition of the results of out-of-school work is held, a large number of specimens of turning, fret-cutting, and the like, are produced; not, perhaps, anything *very elaborate*, as a general rule, but often evincing a good deal of painstaking effort.

Question 20. What text-books are in use, distinguishing between those for the junior and senior classes?—Most of the junior boys are supplied with Nos. 2 and 3 of the recently issued Science primers. The upper boys use such books as Roscoe's or Williamson's Chemistry, Balfour Stewart on Heat, Herschel's Astronomy, Newth's and Wormell's books on Theoretical Physics (Mechanics, Hydrostatics, Optics, &c.), Barff's Chemistry.

Question 21. To what books of reference, other than ordinary school books, have the scholars access?—Some of those mentioned in answer 20 are perhaps rather used as books of reference than as "school books." In addition to them the school library contains, among others,—

Airy's Lectures, &c.
See catalogue of books, pp. 13–19.

Question 22. Is there any Scientific Society or Club in connexion with the school? and if so, who compose it, how is it worked, and what is its influence on the boys?—The Natural History and Polytechnic Society consists *practically*, and has done for many years, of all the scholars and teachers, the subscription being purposely kept almost nominal, about 2*s.* per annum as a minimum. There were times, 20 years ago, or more, when only a small part of the boys joined it; it is now a matter of course for every one to do so. A Committee of elder scholars and teachers, annually elected, manage the affairs, and take care of the collection belonging to the Society. A yearly exhibition is held of collections of plants, shells, insects, &c., made by members during the year, small prizes being given from the Society's funds for them, as well as for Essays, Natural History diaries, Observatory registers, and in the Polytechnic Department, the exhibitions for which are *half-yearly*, for drawings, turnery, fretwork, &c., &c. Photography, electrotyping, taxidermy, the preparation of skeletons, and various other pursuits, have occasionally been added to those mentioned above.

(See Reports sent herewith.)

Tests of Progress.

Question 23. How often is the work tested?—The ordinary school work is registered, and places in class revised by these registers about every six weeks. A written examination, embracing, of course, the scientific as well as the other instruction given in the school, takes place each year before the Midsummer vacation.

A few of the older boys have for the last year or two sat at the South Kensington local examinations in mathematics (elementary), chemistry, and physics; their doing so was not compulsory, but those who had taken an interest in these subjects were encouraged to try the examination this year; three took the mathematics, all of whom passed; eight or nine the physics, six of whom passed; and about 12 the chemistry, of whom three, I believe, failed.

Question 24. In what way? *e.g.* by examination of note books merely, or by oral or written questions?—The class work, of which registers are taken (see 23) is conducted both by oral and written questions.

Question 25. By whom? by the teachers of the subjects, or by an independent examiner?—The class work as above is conducted mainly by the Science teacher, but in the lower classes the ordinary class teacher takes some part of this duty.

The yearly examination questions are proposed by the Superintendent, on the basis of questions prepared and submitted to him by the Science Teacher (and to some extent by the other teachers also). The answers are examined, in the upper classes by the Science teacher, in the lower by the ordinary teacher of the class.

Teachers.

Question 26. Is there any difficulty in procuring competent Science Masters?—Not for our purpose; if we wanted more distinctly technical instruction, the case might be different.

Question 27. Where are the best obtained? Have they been specially trained for the work; and if so, in what does such training consist?—Our late Science Teacher, T. H. Waller, was a B.A. and B.Sc. of the University of London; but I think it is not too much to say that he was pretty much self-taught, beyond the fact that while a scholar with us he acquired a very fair groundwork of scientific knowledge.

His successor, our present Teacher of Science, was similarly trained, and though not equal in brilliancy of scientific ability to his predecessor, he is for our purpose very efficient.

Question 28. What evidence of scientific qualification tendered by candidates is considered of most value?—Having only had to deal with young men trained up in the school as scholars and pupil teachers, we have judged of their qualification rather from our own observation than from any testimonials or diplomas. The London B. Sc. degree we should think amply sufficient as a test of attainment for our purpose; but a real love for scientific pursuits, and thorough ability *as a teacher*, would be even more important.

Question 29. Can you state any results of Science-teaching in the school? such as—

(*a*.) Success, professional or otherwise, of individual scholars.
(*b*.) Influence upon the general studies and intellectual life of the school.

Many of our scholars have afterwards successfully prosecuted the study of various branches of Science, and are at this time carrying on Scientific and Natural History pursuits, mostly in addition to their ordinary avocations.

Several have gone from us to Owens College, and been complimented by the Professors on their knowledge of Science.

Question 30. Are any special rewards or encouragements (*e.g.* exhibitions, scholarships, or prizes) open to successful students of Science in the school?—None beyond those referred to in answer 22, and those offered in connexion with the South Kensington Examinations.

Question 31. What improvements, do you think, could be effected in the teaching of Science in your own school?—The limited time at our disposal for Science seems to me pretty effectively employed. Had we a much larger number of scholars, it might be an advantage to subdivide more minutely, and to take different branches with different classes, so as to provide a more continuous gradation of work, *e.g.*, take chemistry one year, electricity, heat, and optics another, mechanics another, and move the boys on from class to class so as to secure a wider range; but with our numbers, and the limited time that many boys stay with us, this would not be practicable.

Question 32. What are the principal obstacles to the teaching of Science in your own school?—Want of time; the pressure of other studies, deemed equally important.

Question 33. How could the Universities best assist Science-teaching in schools?—Personally, I should be glad of an examination similar to that of the London Matriculation in difficulty, but divided into two sections, so that a boy of good ability in Science and Mathematics might take up, say,—

Euclid I.–IV.
Algebra to quadratics.
Physics and Chemistry as at present, or the Chemistry a little more advanced.
French or German.

And another might take up—

Latin
Greek
English language } as at present.
History
French or German

Many boys leaving school at 16, with no prospect of going to College, like to take the London Matriculation Examination as a test of good school work; but it is so broad in its range as to be beyond the reach of a good many who would find an examination such as I suggest a very useful stimulus. I must particularly guard myself against wishing this *instead* of the present Matriculation Examination, which I hope may not be in any way curtailed for its actual purpose, as a preliminary to studying for a degree; but for many who use it now as the best available test of good schoolwork, without any idea of a College course afterwards, it would be more useful *divided;* a clever boy could still pass in *both* sections, just as at present.

Question 34. Can you suggest any way in which Government could assist Science-teaching in Schools, as, for example, by inspection?

Question 35. Have you any other information to give, or suggestion to make, likely to be helpful to the Commissioners?

FIELDEN THORP, Superintendent.
Nov. 5, 1873. JOHN F. FRYER, Head Master.

TAUNTON COLLEGE SCHOOL.

(SUPPLEMENTARY REPORT.)

The College School, Taunton,
October 18, 1873.

SIR,

IN answering your letter of the 14th inst., I must explain that our science teaching has been so greatly developed during the past year that my former report is obsolete, and has to be almost entirely rewritten. In case the Commissioners may wish to retain my former statements, as illustrative of what can be done towards teaching science in a young school and with imperfect appliances, I leave the old report untouched, and send a fresh statement arranged in accordance with the plan of their Appendix. I should mention that we have recently built a laboratory, added considerably to our apparatus, and engaged a Special Science master of very high reputation.

§ 1. ON THE GENERAL ARRANGEMENT OF SCHOOLS.

The school consists of seven Forms. The sixth and fifth Forms are divided, one side being classical, the other scientific. The scientific side works in the laboratory; the classical side merely attends some of the scientific lectures. The "Remove" has no practical science work, but attends all the lectures; the fourth Form does practical work in the laboratory, and also attends lectures; the third Form receives elementary instruction in Physics.

§ 2. SUMMARY OF THE NUMBER AND AVERAGE AGE OF BOYS LEARNING EACH OF THE VARIOUS SUBJECTS IN THE NATURAL SCIENCE CLASSES.

—	Chemistry.	Botany.	Physics.	Physical Geography.
Number	64	38	15	70
Average age	14–18	15–18	14–15	14–18

§ 3. HOURS PER WEEK GIVEN TO SCIENCE IN THE SEVERAL COLLEGES AND SCHOOLS.

There are two lectures per week in General and Theoretical Chemistry, attended by the four higher Forms. There is one lecture a week on Physical Geography, attended by the same Forms. The "Science side" of Forms VI. and V. works four hours per week in the laboratory. The fourth Form works two hours per week in the laboratory. Each of these classes attends a separate lecture once a week in *vivâ voce* work, and problems in Chemistry and Heat. The VI. and V. Forms attend two lectures a week in Botany.

§ 4. SUBJECTS TAUGHT TO SENIOR AND JUNIOR STUDENTS.

At the present moment the main subjects are Chemistry and Botany. Practical Chemistry occupies a prominent position, being the basis of the laboratory work. In Botany also high value is assigned to practical work, the boys being taught to dissect and classify plants. There is an elementary class in Physics, conducted by experimental teaching; and a more advanced class in Physical Geography. The list of subjects taught has lately been under revision, and the present arrangements are only tentative, and preliminary to a more complete scheme. Thus Physics will ultimately rank as co-ordinate in value with the other leading subjects; Physiology, in which two courses have been conducted, may probably be revived; the Surveying class, which has in past years done much practical work with the theodolite, will be continued; and Meteorology, of which the senior boys have a good working knowledge, derived from daily registration, will be taught to them scientifically. It should be remarked that we possess a complete collection of meteorological instruments, a fairly typical museum of biological preparations, zoological, geological, mineralogical, and botanical specimens, and a botanic garden containing from 700 to 800 selected species.

§ 5. TEXT BOOKS.

In Practical Chemistry no text book is used. A scheme of laboratory practice is dictated, and carefully written down by each boy. In Physical Geography, the master lectures from his own notes, which the boys are expected to reproduce in brief. In aid of the Chemistry lectures, we recommend Roscoe; in Botany, Oliver, and Lindley's *Descriptive Botany;* in Physics, at present confined to the younger boys, Balfour Stewart's *Primer.*

§ 7. METHODS OF TEACHING, AS REGARDS ORAL DEMONSTRATION, BOOK WORK, AND PRACTICAL WORK.

In the laboratory each boy learns the reactions of the metallic and non-metallic bodies. Mixtures are then given of progressive difficulty, the composition of which the pupil detects by his own judgment. Much supervision is employed, in order to cultivate habits of neatness, and skill in manipulation. The course of lectures on Theoretical Chemistry is illustrated by experiments; and there are additional classes in which problems previously given to be worked out of school are verified on the black board. In the same lectures previously assigned portions of the text book are discussed, and questions put on past lectures. High value is attached to the working out of problems, which appear to be a good test of scientific ability. Upon the senior boys is urged the importance of reading scientific books, so that they may acquire mental independence, and not remain a mere shadow of their teacher. Special opportunity is given to all the boys out of school for discussing any difficulties they may encounter. The Botany lectures include dissection and schedule writing, with practice in classification and description.

§ 8. TESTS OF PROGRESS.

Oral questioning in class, and examination of note books after each lecture. Written examinations twice in each term.

§ 9. MOST EFFECTIVE FORM OF LESSON.

Our Science Master is of opinion that the advantages derived from practical and theoretical work are different in kind and cannot easily be compared. But, while assigning equal effectiveness to lectures illustrated by experiment, to practical work, and to discussion of book work, he lays much stress on the necessity of working out problems, as enabling a boy not only to give a verbal enunciation of a law in Chemistry or Physics, but to understand and exhibit its applications.

W. TUCKWELL,
Head Master of Taunton College School.

APPENDIX IV.

HONOURS GAINED AT THE UNIVERSITIES BY SCIENCE STUDENTS FROM THE VARIOUS COLLEGES AND SCHOOLS.

Year	Eton College.	Rugby School.	Harrow School.	Clifton College.	Marlborough College.
1851	None.	1st class, Nat. Sc. Tripos, Cambridge.			A Science Master has been added to the staff too short a time at present to have rendered it possible for boys to win Science Scholarships. A laboratory will probably be built very soon; but the large majority of the boys are distinctly destined by their parents for a *classical* education. FREDERIC W. FARRAR.
1852					
1853		1st class, Nat. Sc. Tripos, Cambridge.			
1854		1st class, Nat. Sc., Oxford.			
1855		1st Honours in Expl. Sc., Trin. Coll., Dublin.	Aldrichian Professor of Chemistry, Oxford.		
1856					
1857			Clinical Professor of Medicine, Oxford.		
			Regius Professor of Medicine, Oxford.		
1858			1st class in Nat. Sc., Oxford.		
1859					
1860			Lee's Reader in Chemistry, Oxford.		
			1st class in Nat. Sc., Oxford.		
1861					
1862			1st class in Nat. Sc., Oxford.		
			1st class in Nat. Sc., Oxford.		
			Lee's Reader in Anatomy, Oxford.		
1863		1st class, Nat. Sc., Oxford.			
1864		1st class, Nat. Sc., Oxford.	1st class in Nat. Sc., Oxford.		
		Nat. Sc. Studentship, Ch. Ch., Oxford.			
1865			Waynflete Professor of Chemistry, Oxford.		
1866			1st class in Nat. Sc., Oxford.		
			Johnson Prize for Astronomy, Oxford.		
1867		Nat. Sc. Studentship, Ch. Ch., Oxford.			
1868		Burdett-Coutts' Geological Scholarship, Oxford.	Radcliffe Travelling Fellowship, Oxford.		
		Nat. Sc. Scholarship, New Coll., Oxford.			
1869		Nat. Sc. Postmastership, Merton Coll., Oxford.			
1870		Nat. Sc. Studentship, Ch. Ch., Oxford.	Foundation Scholarship at Trin. Coll., Cambridge.	Scholarship at Sidney Sussex Coll., Cambridge.	
		Whitworth Exhibition, Oxford.			
		1st class, Nat. Sc., Oxford.			
		1st class, Nat. Sc. Tripos, Cambridge.			
		1st class, Nat. Sc., Oxford.			
1871		Nat. Sc. Studentship, Ch. Ch., Oxford.	*Proxime accessit* for Johnson Prize for Astronomy, Oxford.	Scholarship at Queen's Coll., Oxford.	
		Burdett-Coutts' Geological Scholarship, Oxford.		Scholarship at Pembroke Coll., Cambridge.	
		Nat. Sc. Exhibition, St. John's Coll., Cambridge.			
		1st class, Nat. Sc., Oxford.			
1872		Minor Exhibition in Nat. Sc., Ball. Coll., Oxford.		Junior Studentship at Ch. Ch. Coll., Oxford.	
		1st class, Nat. Sc., Oxford.		Scholarship at St. Peter's Coll., Cambridge.	
		1st class, Nat. Sc., Oxford.		Scholarship at St. Peter's Coll., Cambridge.	
		1st class, Nat. Sc., Oxford.		Demyship at Magdalen Coll., Oxford.	
		1st class, Nat. Sc., Oxford.		2nd class, Sc. School, Oxford.	
		Nat. Sc. Exhibition, St. John's Coll., Cambridge.		The Brackenbury Scholarship at Balliol Coll., Oxford.	
1873		Burdett-Coutts' Geological Scholarship, Oxford.	1st class in Nat. Sc., Oxford.	Scholarship at Clare Coll., Cambridge.	
		1st class, Nat. Sc., Oxford.	1st class in Nat. Sc., Oxford.	Scholarship at St. Peter's Coll., Cambridge.	
		1st class, Nat. Sc., Oxford.	1st class in Nat. Sc. Tripos, Cambridge.	Demyship at Magdalen Coll., Oxford.	

(*continued.*)

Year.	Winchester College.	St. Peter's College, Westminster.	Wellington College.	Cheltenham College.*	Rossall School.	Charterhouse School.	Christ's Hospital School.
1851			None.				
1852							
1853							
1854					1st Sc. Honours, Dublin.		
1855							
1856							
1857		1st class, Nat. Sc., Oxford.					
1858							
1859		2nd class, Nat. Sc., Oxford.					
1860		Radcliffe Travelling Fellowship.			1st class, Nat. Sc. and Geol. Scholarship, Oxford.		
1861		2nd class, Nat. Sc., Oxford.					
1862							
1863					Nat. Sc. Scholarship, Magdalen Coll., Oxford.		
1864	1st class, Nat. Sc., Oxford.					A Scholarship for Nat. Sc. and Math., King's Coll., Cambridge.	
1865				1st class, Nat. Sc., Oxford.			
1866							
1867					1st class, Nat. Sc., Oxford.		
1868		2nd class, Nat. Sc., Oxford.					
1869	A Demyship at Mag. Coll., Oxford. Two 1st class, Nat. Sc., Oxford. One 2nd class, Nat. Sc., Oxford.						Whitworth Scholarship, St. John's Coll., Cambridge.
1870	1st class, Nat. Sc., Oxford.	Burdett-Coutts Scholarship, Oxford.		Exhibition at Balliol Coll., Oxford.		A Scholarship for Nat. Sc., Clare College, Cambridge.	Senior in Nat. Sc. Tripos, Queen's Coll., Cambridge. 1st class, Nat. Sc., Jesus' Coll., Cambridge.
1871		1st class, Nat. Sc., Oxford. 3rd class, Nat. Sc., Cambridge.			Nat. Sc. Scholarship, St. John's, Cambridge.		2nd class, Nat. Sc. Tripos, Downing Coll., Cambridge.
1872	1st class, Nat. Sc., Oxford. Radcliffe Fellowship, Oxford.						Radcliffe Travelling Fellowship.
1873							Exhibition, Magdalen Coll., Oxford (elected at the same time to a Postmastership at Merton, but selected Magdalen).

---

* N.B.—It is not at the Universities but at the examinations for the Indian Civil Service for Cooper's Hill, and for Woolwich, that students of Natural Science from both Departments of Cheltenham College usually present themselves.

T. W. JEX-BLAKE.

(*continued.*)

Year.	City of London School.*	Dulwich College.	Taunton College School.	King's College School.	University College School.	Manchester Grammar School.
1851		None.	The improved arrangements for Science teaching and the engagement of a special Master date only from May 1873; no boys have, therefore been as yet sent up for University distinctions. W. TUCKWELL.		(See separate returns.)	
1852						
1853						
1854						
1855						
1856						
1857						
1858						
1859						
1860						
1861						
1862						
1863	Open Nat. Sc. Exhibition, Magdalen Coll., Oxford.					
1864						
1865						
1866	1st class Honours in Chemistry and Nat. Philosophy, London Univ.					
1867	Degree of M.B., London, with 1st place. Degree of B.Sc. with 1st class Honours in Zoology, London.			1st class, Nat. Sc., Oxford.		
1868	Whitworth Exhibition for Mechanical Sc., Univ. of London.					
1869	Open Scholarship for Nat. Sc., St. John's Coll., Cambridge. Two Exhibitions, Univ. of London. Degree of M.B. and B.S., Lond., with 1st class Honours in Medicine, and first in 1st class Honours (and gold medal) in Surgery, with an University Science Scholarship; also an Exhibition, and first in 1st class in Botany and Zoology.			Honours in Botany, Prel. Sc., Univ. of London.		Exhibition, Balliol Coll., Oxford. Studentship, Ch. Ch., Oxford.
1870	Nat. Sc. Scholarship, St. John's Coll., Cambridge. 1st class, Nat. Sc., Cambridge.			Honours in Zoology, Prel. Sc., Univ. of London. Nat. Sc. Scholarship, Christ's, Cambridge.		Studentship, Ch. Ch., Oxford. Exhibition, Wadham Coll., Oxford.
1871	Degree of B.Sc., in Honours, London.			Honours in Chemistry, Prel. Sc., Univ. of London.		Scholarship, Merton Coll., Oxford. Exhibition, Merton Coll., Oxford. Studentship, Ch. Ch., Oxford. Second Class Sc. School, Oxford. Scholarship, Caius Coll., Cambridge.
1872	Degree of D.Sc., London, placed first in 1st class in Geology and Palæontology. Degree of B.Sc., London, in 1st class. Degree of M.D., M.Ch., L.M., in Honours, Queen's Univ., Ireland, with 1st prize in Anatomy and Medicine. Third in 1st class in Nat. Sc. Tripos, Cambridge.			Honours in Zoology, Prel. Sc., London. Gold Medal for Nat. Phily.; 1st B. Sc. Examination, London. 1st class, Nat. Sc., Cambridge. Radcliffe Sc. Studentship, Oxford.		Demyship, Magdalen Coll., Oxford. Brackenbury Exhibition, Balliol College, Oxford. Studentship, Ch. Ch., Oxford.
1873						Studentship, Ch. Ch., Oxford. Second Class Sc. School, Oxford. Scholarship, Pembroke Coll., Cambridge. Brackenbury Exhibition, Balliol Coll., Oxford.

* [*See also*, the list of Honours given in the Return from this School in pp. 99–103.]

Natural Science Honours obtained by former Pupils of University College School.

N.B.—The list includes,—

(1.) *Honours in Mathematics* in cases where the examinations in Natural Philosophy are not distinct from those in Pure Mathematics; and,

(2.) *Fellowships, Scholarships and Prizes given without specification of subject* when the presumable ground of award was distinction in Mathematics and Natural Philosophy.

March 1874.

1838.

University of London.—Matriculation Honours: Two mentions in Mathematics and Natural Philosophy.

1839.

University of London.—Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1841.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior optime (with first class in Classics).

University of London.—1st M.B. Honours: Gold medal and mention in Anatomy and Physiology; mention in Materia Medica and Pharmaceutical Chemistry.

Matriculation Honours: Exhibition in Mathematics and Natural Philosophy.

1842.

University of Cambridge.—Pembroke College. Scholarship; prize.

1843.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior optime.

University of London.—First M.B. Honours: Exhibition and gold medal in Chemistry; mention in Anatomy and Physiology; exhibition and gold medal in Materia Medica and Pharmaceutical Chemistry.

Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1844.

University of London.—B.A. Honours: Prize in Chemistry.

Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1845.

University of London.—B.A. Honours: Scholarship in Mathematics and Natural Philosophy.

Matriculation Honours: Exhibition and mention in Mathematics and Natural Philosophy.

1846.

University of London.—First M.B. Honours: Gold medal in Materia Medica and Pharmaceutical Chemistry.

1847.

University of Cambridge.—St. John's College. Prize.

University of London.—B.A. Honours: Scholarship in Mathematics and Natural Philosophy.

Matriculation Honours: Exhibition and mention in Mathematics and Natural Philosophy.

1848.

University of Cambridge.—St. John's College. Prize.

Trinity College. Two prizes.

University of London.—B.A. Honours: Scholarship in Mathematics and Natural Philosophy.

Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1849.

University of Cambridge.—St. John's College. Scholarship; prize.

Trinity College. Scholarship; prize.

University of London.—B.A. Honours: Scholarship in Mathematics and Natural Philosophy; three mentions in Animal Physiology.

1850.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Fourth wranglership; senior optime.

Trinity College. Prize.

Emmanuel College. Scholarship; prize.

University of London.—B.A. Honours: Scholarship in Mathematics and Natural Philosophy.

Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1851.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Third wranglership and second Smith's prize.

St. Peter's College. Scholarship; prize in Mathematics.

Trinity College. Prize for Mathematics.

Emmanuel College. Scholarship; prize.

University of London.—B.A. Honours: Mention in Animal Physiology; mention in Botany.

Matriculation Honours: Mention in Chemistry.

1852.

University of Cambridge.—B.A. Honours: Natural Sciences: First class.

St. Peter's College. Prize in Mathematics.

St. John's College. Fellowship.

Trinity College. Two prizes.

Emmanuel College. Prize.

University of London.—M.A. Examination: Gold medal in Mathematics and Natural Philosophy.

B.A. Honours: Mention in Animal Physiology.

First M.B. Honours: Gold medal in Chemistry; mention in Anatomy and Physiology; mention in Botany.

Matriculation Honours: Two mentions in Mathematics and Natural Philosophy; two mentions in Chemistry; prize in Botany.

1853.

University of Oxford.—Moderations: First class in Mathematics (together with first class in Classics).

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Second wranglership; second Smith's prize.

St. Peter's College. Prize in Mathematics.

Caius College. Scholarship.

Trinity College. Fellowship; scholarship; prize.

Emmanuel College. Fellowship.

University of London.—M.A. Examination: Gold medal in Mathematics and Natural Philosophy.

B.A. Honours: Mention in Chemistry.

Matriculation Honours: Mention in Mathematics and Natural Philosophy.

1854.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior wranglership; equal first Smith's prize.

Caius College. Prize in Mathematics.

Trinity Hall. Two scholarships; prize.

Trinity College. Prize.

University of London.—M.B. Honours: Gold medal in Physiology and Comparative Anatomy.

B.A. Honours: Mention in Mathematics and Natural Philosophy; mention in Animal Physiology.

Matriculation Honours: Two mentions in Mathematics and Natural Philosophy; mention in Zoology.

1855.

University of Oxford.—B.A. Honours: Third class in Mathematics and Physics (with third class in Classics).

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Fourth wranglership.

St. Peter's College. Fellowship.

Trinity Hall. Prize in Mathematics.

Trinity College. Prize for Mathematics.

University of London.—B.A. Honours: Mention in Mathematics and Natural Philosophy; mention in Animal Physiology.

Matriculation Honours: Three mentions in Mathematics and Natural Philosophy.

1856.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior optime; senior optime (with first class in Classics).

Trinity College. Fellowship; two prizes.

University of London.—B.A. Honours: Mention in Mathematics and Natural Philosophy.

First M.B. Honours: Gold medal in Botany; mention in Materia Medica.

Matriculation Honours: Exhibition and mention in Mathematics and Natural Philosophy.

1857.

University of Cambridge.—B.A. Honours; Mathematics and Natural Philosophy; Ninth wranglership; senior optime.

Trinity Hall. Fellowship.

Trinity College. Scholarship; prize.

University of London.—B.A. Honours; Mention in Mathematics and Natural Philosophy; mention in Animal Physiology.

1858.

University of Cambridge.—Trinity College. Prize.

University of London.—B.A. Honours: Scholarship and mention in Mathematics and Natural Philosophy; mention in Animal Physiology; mention in Botany.

Matriculation Honours: Mention in Mathematics and Natural Philosophy; two mentions in Chemistry.

1859.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Sixteenth wranglership.

University of London.—M.A. Examination: Two degrees in Mathematics and Natural Philosophy.

M.B. Honours: Gold medal in Physiology and Comparative Anatomy.

Matriculation Honours: Three mentions in Mathematics and Natural Philosophy; mention in Chemistry.

1860.

University of Cambridge.—B. A. Honours: Mathematics and Natural Philosophy: Junior optime.

University of London.—M.A. Examination: Gold medal in Mathematics and Natural Philosophy.

B.A. Honours: Mention in Mathematics and Natural Philosophy; prize in Animal Physiology.

First B.A. Honours: Two mentions in Mathematics and Mechanical Philosophy.

Matriculation Honours: Three mentions in Mathematics and Natural Philosophy.

1861.

University of Cambridge.—Trinity College. Fellowship; minor scholarship.

University of London.—B.A. Honours: Mention in Mathematics and Natural Philosophy.

First B.A. Honours: Three mentions in Mathematics and Mechanical Philosophy.

Prel. Sci. (M.B.) Honours: Exhibition in Chemistry and Natural Philosophy.

Matriculation Honours: Three mentions in Mathematics and Natural Philosophy; two mentions in Chemistry.

1862.

University of Oxford.—B.A. Honours: Mathematics and Physics: Fourth class (with first class in Classics).

University of Cambridge.—Trinity College. Two prizes.

University of London.—B. Sc. Honours: Mention in Mathematics and Natural Philosophy.

B.A. Honours: Mention in Mathematics and Natural Philosophy.

First M.B. Honours: Exhibition and gold medal in Organic Chemistry; mention in Physiology, Histology and Comparative Anatomy.

First B. Sc. Honours: First place in Chemistry; mention in Biology.

Prel. Sci. (M.B.) Honours: Mention in Chemistry and Natural Philosophy.

Matriculation Honours: Two mentions in Mathematics and Natural Philosophy; mention in Zoology.

1863.

University of Cambridge.—Trinity College. Scholarship.

University of London.—M.A. Examination: Two degrees (one with gold medal) in Mathematics and Natural Philosophy.

B. Sc. Honours: First class with scholarship in Chemistry; second class and third class in Biology; second class in Geology.

B.A. Honours: First class with prize, and two second classes in Animal Physiology.

First B.A. Honours: Second class in Mathematics and Mechanical Philosophy.

Prel. Sci. (M.B.) Honours: First class with exhibition in Biology.

Matriculation Honours: Two mentions in Chemistry.

1864.

University of Cambridge.—Trinity College. Prize.

University of London.—B. Sc. Honours: First class in Logic and Moral Philosophy.

B.A. Honours: First class with scholarship in Mathematics and Natural Philosophy; first class with prize in Animal Physiology.

First M.B. Honours: First class with exhibition and medal in Physiology, Histology and Comparative Anatomy; first class in Organic Chemistry.

Matriculation* General Honours: Two prizes and two mentions.

1865.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Eighth wranglership; senior optime.

Trinity College. Minor scholarship.

Sidney Sussex College. Entrance scholarship.

University of London.—B.A. Honours: Second class in Animal Physiology.

Prel. Sci. (M.B.) Honours: First class in Chemistry and Natural Philosophy.

Matriculation General Honours: Exhibition and three mentions.

1866.

University of Cambridge.—Trinity College. Two prizes.

Sidney Sussex College. Prize in Mathematics; prize in Natural Science.

University of London.—Prel. Sci. (M.B.) Honours: Second class in Biology.

Matriculation General Honours: First place with exhibition and two mentions.

1867.

University of Oxford.—Moderations: Third class in Mathematics.

University of Cambridge.—Trinity College. Scholarship; prize.

Sidney Sussex College. Prize in Mathematics.

Downing College. Minor scholarship.

University of London.—First B.A. Honours: Second class in Mathematics and Mechanical Philosophy.

Matriculation General Honours: First Place with exhibition and two mentions.

1868.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior optime.

St. Peter's College. Entrance Science scholarship.

Trinity College. Prize.

Downing College. Prize in Mathematics.

University of London.—B.A. Honours: Second class in Animal Physiology.

First M.B. Honours: First class with gold medal in Organic Chemistry.

First B. Sc. Honours: Second class and two third classes in Chemistry and Natural Philosophy; third class in Botany: First class in Zoology.

First B.A. Honours: Second class in Mathematics and Mechanical Philosophy.

Prel. Sci. (M.B.) Honours: Second class and third class in Chemistry and Natural Philosophy; first class in Zoology; third class in Botany.

Matriculation General Honours: Exhibition and two mentions.

---

* The examinations for special subjects, including Mathematics and Natural Philosophy, Chemistry, Botany, Zoology, were discontinued in 1864. Honours have since been awarded for general merit displayed in the subjects of the Pass examination. The examination embraces Mathematics, Natural Philosophy, and Chemistry, but not Botany or Zoology.

1869.

University of Oxford.—B.A. Honours: Mathematics and Physics: Third class.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy: Senior wranglership; second Smith's prize.

St. John's College. Natural Science Exhibition.

Trinity College. Minor Scholarship; prize for Mathematics.

Sidney Sussex College. First entrance scholarship in Mathematics.

Downing College. Scholarship; prize in Mathematics.

University of London.—B. Sc. Honours: First class in Chemistry; first class in Zoology; first class in Logic and Moral Philosophy.

Prel. Sci. (M.B.) Honours: Third class in Botany.

Matriculation General Honours: Exhibition, four prizes, and four mentions.

1870.

University of Oxford.—B.A. Honours: Natural Science: Second class.

Moderations: Mathematics: Second class.

University of Cambridge.—St. John's College. Scholarship in Natural Science; prize in Natural Science.

Sidney Sussex College. Scholarship; prize in Mathematics.

Downing College. Prize in Mathematics.

University of London.—First B. Sc. Honours: Second class in Chemistry.

Prel. Sci. (M.B.) Honours: Second class in Chemistry.

Matriculation General Honours: Second place with exhibition in January Examination; second place with exhibition in June Examination; three prizes and four mentions.

1871.

Royal Society.—Fellowship.

University of Oxford.—B.A. Honours: Mathematics and Physics: Third class.

University of Cambridge.—Hon. M.A. for distinction in Natural Science.

B.A. Honours: Mathematics and Natural Philosophy: Senior optime.

St. John's College. Prize in Natural Science.

Trinity College. Fellowship for Natural Science; scholarship; open scholarship in Natural Science; prize.

Sidney Sussex College. Prize in Mathematics.

University of Dublin.—First senior moderatorship in Natural Science.

University of London.—First B. Sc. Honours: Second class in Experimental Physics; second class in Chemistry.

Prel. Sci. (M.B.) Honours: Second class in Chemistry.

Matriculation General Honours: First place with exhibition.

1872.

Royal Society.—Four fellowships.

University of Cambridge.—B.A. Honours: Natural Sciences: First place in first class.

Trinity College. Prize.

Sidney Sussex College. Scholarship.

University of London.—D. Sc.; Degree in Electricity.

B. Sc. Honours: First class with scholarship in Chemistry.

Matriculation General Honours: First place with exhibition; third place with exhibition; two mentions.

University of Glasgow.—Prize in Mechanics; two prizes in Natural Philosophy.

1873.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy, senior optime; Natural Sciences, second class.

Trinity Hall. Entrance scholarship in Mathematics.

St. John's College. Fellowship for distinction in Natural Science; prize.

Trinity College. Entrance exhibition; prize.

University of London.—M.A. Examination: Gold medal in Mathematics and Natural Philosophy.

First B. Sc. Honours: First class in Chemistry; third class in Experimental Physics.

Prel. Sci. (M.B.) Honours: Second class in Experimental Physics.

Matriculation General Honours: Two exhibitions; prize; mention.

1874.

University of Cambridge.—B.A. Honours: Mathematics and Natural Philosophy; second wranglership and first Smith's prize.

University of London.—Matriculation General Honours: Two mentions.

List of former Pupils of University College School, distinguished in Science.

(I.) *Natural Science.*

Abraham, P. S., B. Sc. London, B.A. Dublin

B. Sc. London (1869) First Class Honours; B.A. Dublin (1871) First Senior Moderator in Natural Science.

Atkinson, R. W., B. Sc. London:

B. Sc. (1872) Scholar in Chemistry; Demonstrator of Birkbeck Laboratory, University College, London.

Ayrton, W. E.:

Professor of Natural Philosophy, Yeddo, Japan; late Assistant Electrical Superintendent of Indian Government Telegraphs, and recently in charge at Mitcham as representative of the Great Western Telegraph Company's engineers.

Bennett, F. J.:

Assistant Geologist, Geological Survey of the United Kingdom.

Carpenter, W. L., B.A. and B. Sc. London; B.A. (1860); B. Sc. (1862).

Dillon, Ed., B.A. London:

B.A. (1868), Associate of the Royal School of Mines in Metallurgy and Mining (1871–72), Chief Assayer, Imperial Mint, Osaka, Japan.

Fleming, J. A., B. Sc. London:

B. Sc. (1870); Assistant Demonstrator in the Advanced Laboratory, Royal College of Chemistry; late Science Master at Rossall School.

Foster, Michael, B.A. and M.D. London; M.A. Cambridge, F.R.S.

B.A. (1854) Scholar in Classics; Hon. M.A. Cambridge (1871); Fellow of University College, London, and of Trinity College, Cambridge; Prælector in Physiology, Trinity College, Cambridge; late Professor of Physiology, Royal Institution, and Professor of Practical Physiology, University College, London.

Garrod, A. H., B.A. Cambridge:

B.A. (1872) Head of Natural Sciences Tripos; Fellow of St. John's College, Cambridge; Prosector to the Zoological Society.

Graham, J. C., B. Sc. London:

B. Sc. (1871).

Guthrie, Fred., B.A. London, F.R.S.:

B.A. (1852) Professor of Physics, Royal School of Mines.

Harding, P. J., B.A. Cambridge:

Late Scholar of Sidney Sussex College, Cambridge; late Lecturer in Applied Mathematics, University College, London; Assistant Examiner in Experimental Physics, University of London.

Jevons, W. S., M.A. London, F.R.S.:

M.A. (1862) Gold Medal in Logic and Moral Philosophy; Professor of Political Economy and of Mental Philosophy, Owens College, Manchester; formerly Assayer, Royal Mint, Sydney, N.S.W.

Knox, G. W., B. Sc. London:

B. Sc. (1863) Scholar in Chemistry; Mining Engineer.

Magnus, Rev. P., B.A. and B. Sc. London:

B.A. (1863) First Class Honours; B. Sc. (1864) First Class Honours.

Muirhead, Alex., D. Sc. London:

B. Sc. (1869) First Class Honours; D. Sc. (1872) in Electricity; Member of Council of Society of Telegraph Engineers.

Orme, T. A.:

Teacher of Chemistry and Chemical Physics, University College School; Author of "An Introduction to the Science of Heat."

(II.) *Mathematical Science.*

Adler, M. N., M.A. London:

M.A. (1859) in Mathematics and Natural Philosophy; Fellow of University College, London; Actuary.

Ball, W. W. R., M.A. London; B.A. Cambridge:
M.A. London (1873) Gold Medal in Mathematics and Natural Philosophy; B.A. Cambridge (1874) Second Wrangler; First Smith's Prize; Scholar of Trinity College, Cambridge.

Batty, Rev. R. B., M.A. London and Cambridge (the late):
M.A. London (1852) Gold Medal in Mathematics and Natural Philosophy; B.A. Cambridge (1853) Second Wrangler; Second Smith's Prize; Fellow of Emmanuel College, Cambridge.

Crompton, Chas., M.A. Cambridge:
B.A. (1855) Fourth Wrangler; late Fellow of Trinity College, Cambridge; Barrister-at-law.

De Morgan, G. C., M.A. London (the late):
M.A. (1863) Gold Medal in Mathematics and Natural Philosophy.

Guthrie, Francis, B.A. and LL.B. London:
B.A. (1850) Scholar in Mathematics and Natural Philosophy; LL.B. (1852) Scholar; Fellow of University College, London; Barrister-at-law.

Hartog, N. E., B. A. London and Cambridge (the late):
B.A. London (1864) Scholar in Mathematics, Scholar in Classics, Prize in Animal Physiology; B.A. Cambridge (1869) Senior Wrangler; Second Smith's Prize; Fellow of University College, London, and Scholar of Trinity College, Cambridge.

Hayward, R. B., B.A. London; M.A. Cambridge:
B.A. London (1847) Scholar in Mathematics and Natural Philosophy; B.A. Cambridge (1850) Fourth Wrangler; Fellow of University College, London, and late Fellow of St. John's College, Cambridge; Mathematical Master at Harrow School.

Hutton, R. H., M.A. London:
B.A. (1845) Scholar in Mathematics and Natural Philosophy; M.A. London (1849) Gold Medal in Logic and Moral Philosophy; Fellow of University College, London, and Member of the Senate of the University of London.

Kisch, B., B. Sc. and M.A. London:
M.A. (1863) in Mathematics and Natural Philosophy.

Nesbitt, H. A., M.A. London:
M.A. (1859) in Mathematics and Natural Philosophy.

Routh, E. J., M.A. London and Cambridge, F.R.S.
M.A. London (1853) Gold Medal in Mathematics and Natural Philosophy; B.A. Cambridge (1854) Senior Wrangler and Equal First Smith's Prize; late Fellow of St. Peter's College, Cambridge.

Smith, Lumley, M.A. Cambridge:
B.A. (1857) Ninth Wrangler; Fellow of Trinity Hall, Cambridge; Barrister-at-law.

Solomon, J. M., M.A. London:
M A. (1860) Gold Medal in Mathematics and Natural Philosophy; Student of the Inns of Court, 1863; Fellow of University College, London; Barrister-at-law.

Taylor, Sedley, M.A. Cambridge:
B.A. (1859) Sixteenth Wrangler; Fellow of Trinity College, Cambridge.

Watson, Rev. H. C., M.A. Cambridge:
B.A. (1865) Eighth Wrangler; late Scholar of Trinity College, Cambridge; Assistant Master at Clifton College.

Yool, G. V., M.A. Cambridge:
B.A. (1851) Third Wrangler and Second Smith's Prize: First Class, Natural Sciences Tripos (1852); late Fellow of Trinity College, Cambridge; Barrister-at-law.

(III.) *Medical Science.*

Arnott, Hy., F.R.C.S.:
F.R.C.S. (1868) Joint Lecturer on Morbid Anatomy, St. Thomas's Hospital; late Joint Lecturer on Pathology, Middlesex Hospital.

Atkinson, W., B.A. London:
B.A. (1857) Staff Surgeon, Army Medical Service.

Aveling, C. T., M.S. and M.D., London:
M.S. (1872) M.D. (1873); late House Surgeon, St. Thomas's Hospital.

Bruce, Alex., B. Sc., M.B. and M.S., London: (the late).
B. Sc.—M.S. (1863–66), (two exhibitions and gold medal); Scholar of University College, London, and Assistant Curator of the Museum of Anatomy and Pathology (1866–68) University College.

Buchanan, Albt., B.A. and M.B. London:
B.A. (1854) in Honours; M.B. (1861).

Buchanan, George, B.A. and M.D. London:
B.A. (1851) in Honours; First M.B. Gold Medal; M.B. (1854) Gold Medal in Physiology, Scholar and Medal in Surgery, Scholar and Medal in Medicine; M.D. (1855); Fellow of University College, London; Inspector, Medical Department of the Privy Council.

Burgon, Jos.:
First M.B. (1846) Gold Medal.

Colgate, Hy., M.B. and B.S. London:
M.B. (1873) Scholar and Gold Medal; B.S. (1873) Gold Medal.

Cumberbatch, A. E., M.B. London:
Scholar of St. Bartholomew's (1868); M.B. (1871); Demonstrator of Anatomy, St. Bartholomew's Hospital.

Filliter, Wm., M.B. London, M.D. (the late):
M.B. (1850).

Gamgee, Arthur, M.D., Edinburgh; F.R.S. L. and E.:
M.D. (1862) Thesis Gold Medal; Professor of Practical Physiology and Histology, Owens College, Manchester; Examiner in Forensic Medicine, University of London; late Lecturer on Physiology, Surgeons' Hall, Edinburgh.

Gasquet, J. R., M.B. London:
M.B. (1852), Gold Medal.

Hakes, Jas., F.R.C.S.:
First M.B. London (1843) Exhibition and Medal in Chemistry; Exhibition and Medal in Materia Medica; Honorary Surgeon, Liverpool Royal Infirmary.

Harding, A. W., B.A. and M.B. London:
B.A. (1867) First Class Honours; M.B. (1871) late Radcliffe Student, Oxford; House Surgeon, Infirmary for Children, Liverpool.

Hill, Berkeley, M.B. London:
M.B. (1859) Gold Medal; Surgeon and Teacher of Practical Surgery, University College Hospital.

Howse, H. G., M.B. and M.S. London:
M.B. (1866) Gold Medal and "Deserving of Scholarship;" B.S. (1867) Scholar and Gold Medal; M.S. (1868) "Worthy of Medal;" Senior Assistant Surgeon and Lecturer on Anatomy, and Demonstrator of Morbid Histology, Guy's Hospital.

Matthew, T. P.:
First M.B. London (1841) Gold Medal.

Nunneley, F. B., B.S. and M.D. London:
B.S. (1866) Scholar and Gold Medal; M.D. (1867) "Deserving of Medal," and "Distinguished by Special Proficiency;" Fellow of University College, London; late Assistant Physician, and Lecturer on Experimental Physiology and Histology, St. Mary's Hospital.

Powell, W., M.B. London:
M.B. (1862) in Honours; House Surgeon, Torbay Infirmary; late Resident Medical Officer, London Hospital.

Power, W. H. T., B.A. London:
B.A. (1857); Surgeon Major, Indian Army Medical Service (appointment by open competition).

Schlesinger, B. M.:
Scholar in Pathology and Assistant Curator (1873); late Scholar and Assistant Demonstrator in Anatomy, St. Mary's Hospital.

Sibley, S. W., F.R.C.S.:
F.R.C.S. (1857) late Lecturer on Pathological Anatomy, Middlesex Hospital.

Smith, H. Alder, F.R.C.S.:
First M.B. London (1868) Gold Medal; late Scholar, House Surgeon, and House Physician, St. Bartholomew's Hospital.

Smith, W. J.:
First M.B. London (1856) Gold Medal.

Tapson, A. J., M.B. London:
M.B. (1843) in Honours.

Thompson, J. A.:
Prize Essay, Guy's Hospital (1868); late Resident Accoucheur, Middlesex Hospital.

Turle, Jas., M.D. Edinburgh:
M.D. (1857) Thesis Gold Medal.

Waller, A., B.A. and B. Sc. London:
B.A. (1865) in Honours; B. Sc. (1866); late House Surgeon, St. Thomas's Hospital.

Winterbotham, L.:
M.R.C.S. (1856) Consulting Surgeon, Cheltenham General Hospital.

APPENDIX V.

RETURNS FROM THE HEAD MASTERS OF CERTAIN ENDOWED SCHOOLS IN ENGLAND AND WALES FOR SECONDARY EDUCATION HAVING (AS STATED IN THE REPORT OF THE SCHOOLS INQUIRY COMMISSION) ANNUAL ENDOWMENTS OF 200*l.* AND UPWARDS.

A.

[The following letter and form were sent to the Head Masters of two hundred and five Endowed Schools in England and Wales, on the 30th June 1871.]

Royal Commission on Scientific Instruction and the Advancement of Science,
6, Old Palace Yard, S.W., 30th June 1871.

Sir,

I am directed by the Duke of Devonshire, the Chairman of this Commission, to beg that you will be so good as to aid the Commissioners in the Inquiries which have been entrusted to them by filling up the enclosed form, and returning it, together with any additional information respecting the Teaching of Science in your School which you may be good enough to afford, with the least possible delay.

I have the honour to be, &c.

J. Norman Lockyer, Secretary.

County ____________________

Endowed School at ____________________

Net annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.	Amount expended in Teaching.		
					Classics.	Mathematics.	Natural Science
					£ s. d.	£ s. d.	£ s. d.

Remarks.—

[The following returns have been received in answer to the foregoing letter.]

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
ANGLESEY. **Beaumaris.**				
—	—	—	—	—
BEDFORD. **Bedford.**				
* 4,199*l*. - † 640*l*.	‡None.	—	—	None.
Bedford (Commercial School).				
Income derived from the estates of the Harpur Charity about 1,800*l*. per annum. Two Exhibitions of 50*l*. each for four years.	None.	—	—	No laboratory; no aids whatever.
BERKS. **Abingdon.**				
Income about 350*l*. - Scholarships 250*l*.‖	A few boys have instruction in Botany.	—	—	—
BRECKNOCK. **Brecon (Christ's College).**				
Income - - £800 Exhibition, 40*l*. a year (assigned triennially).	—	32	—	—
CAMBRIDGE. **Cambridge.**				
About 600*l*. (no Exhibitions).	None.	30	No Exhibitions.	None.
CHESHIRE. **Chester Cathedral Grammar School.**				
200*l*. per annum paid to *two* Masters by the Dean and Chapter.¶	About 20.	*General* Instruction, 30 hours per week; *Scientific*, perhaps two hours per week.	—	A small quantity of apparatus, but the want of class-rooms prevents it being frequently used.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
—	—	—	There is no organised system of instruction in Natural Science, but lessons in the elements of some branch of it are given twice a week to such boys as appear likely to profit by it, usually about 10 in number, by the Mathematical Master. W. Bedell Stanford, M.A., Head Master.
1,000§ 841 250 150 150 200 80 50 2,721	280 125 80 80 20 30 615	—	* This is the sum which appears in the published accounts of the Harpur Charity as expended on the Grammar School from Midsummer 1868 to Midsummer 1869. It includes sundry expenses for gas, &c. The sum must be somewhat larger in the present year. It includes Drawing and Modern Languages. † *i.e.*, eight Exhibitions, 80*l.* each (two fall vacant every year; they are tenable for four years). ‡ Occasionally an individual boy receives part of his preparation for Matriculation at London University from the Mathematical Master. § It is almost impossible to specify the sum *actually* spent on "*Classics*" and "*Mathematics*" respectively. *i.e.* Salaries of various Masters whose main subject is *Classics*, Divinity, with History, &c. *i.e.* Salaries of Masters in Mathematics, Arithmetic, and Elementary English. N.B.—The new scheme prepared by the Endowed Schools' Commissioners contemplates instruction in Natural Science. No steps have as yet been taken by the Trustees for establishing this branch. It is much wanted for many boys. Exhibitions *may* be given (and sometimes *are*) for mathematical *excellence*, provided that the Classics are up to a "pass" standard. July 11, 1871. F. Fanshawe, Head Master.
Classics, Mathematics, French, German, and English exhaust the whole income.		—	The introduction of the study of Natural Science has been long thought about, but the changes impending the government of this Charity have hitherto stood in the way of this and other improvements. An effort, however, will be made after the Midsummer recess to introduce some branch of the subject into the school. July 11th, 1871. W. Finlinson, Head Master.
—	—	—	The school buildings have been lately rebuilt, and the school is now making a fresh start under a new Head Master, who is desirous of encouraging certain branches for the cultivation of which the neighbourhood to Oxford offers advantages. ‖ These are not in the gift of the school; Pembroke College, Oxford, elects. E. Summers, M.A., Head Master.
—	—	—	The College labours under a debt of 2,500*l.* for its buildings, payable by instalments of 125*l.* (with interest at four per cent., 100*l.*), during the next 20 years 800*l.*, 225*l.*, 575*l.* net. If there has been no supply of Natural Science, there has been hitherto no demand. The amount "expended on teaching Classics and Mathematics" [French, German if necessary, Drawing, and English] differs from the total income only by what is wanted for repairs (more properly by even less, for the income is ill sufficient) by the 40*l.* exhibition, and a 21*l.* pension to a late Head Master, before the Act of 1853 and Scheme of 1845. The three Masters have endowments, together = 415*l.*, and portions of the fees. A fourth is engaged by and at the cost of the Head Master. On his part there is no obstacle offered to Natural Science except in his incapacity to make much of it personally. J. D. Williams, M.A., Trinity College, Cambridge.
600*l.* for both, with English.		Nothing.	The Head Master has for some time been anxious to begin a system of teaching in Natural Science; but there are considerable difficulties. There are 100 Free Boys, for whom there are only three Masters. These Free Boys may stay until they are 18 years old; many do stay, and require considerable teaching in Classics and Mathematics. The endowment is very small, so that there is no surplus fund either to pay a Natural Science Master, or to build. Again, the decree forbids *any charge* to be made to the Free Boys, so that no extra subjects can be introduced, at least *as part of the general system*. These remarks have been limited to Free Boys, as the great number of them checks every possible improvement. They pay 1*l.* per annum. This 100*l.* pays the Third Master, whose special duty is to teach English subjects. It would be possible to start a Voluntary Class in Science *out of school hours*; but the Head Master does not think such a method of teaching any subject an advisable course. The above remarks apply with equal force to French and German. The Head Master is hopeful that the Endowed Schools' Commissioners will do him great service in the matter.
—	—	—	¶ The Cathedral statutes provide for four valuable Exhibitions to Oxford and Cambridge, but they have not been awarded for several generations. The Dean and Chapter cannot be *persuaded* to revive them. Perhaps the Endowed Schools' Commissioners may prevail upon the Ecclesiastical Commissioners to restore them. The sum assigned by the Statutes for each Exhibition is *one fourth* of the statutable stipend of a Canon. The *present* income of a Canon is about 550*l.* per annum. I inclose some papers, which may possibly assist you in your inquiries. July 10, 1871. James Harris, M.A., Cantab., Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
CHESHIRE—*cont.* **Macclesfield.**				
Income, 1,200*l.*; Exhibitions, 150*l.*	Those who do not learn Greek, say 6.	About 2.	None as yet.	No.
Macclesfield (the Modern School).				
1,250*l.*	40.	—	None.	Chemical laboratory.
Northwich.				
—	6	2	—	—
Sandbach.				
School receives 215*l.* from Charity estates. No Exhibitions.	About 24.	6 to 7 hours.	—	Laboratory.
Stockport.				
Endowment - - £300 Rest of income variable, derived from school fees.	—	28	None.	No.
DERBY. **Repton.**				
Income - - £1,200 Out of this 460*l.* for Scholarships at the School, and Exhibitions to the University.	100 regularly.	2	None. Exhibitions given for the most part by private patronage.	No.
Risley.				
—	—	—	—	—

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d. —	£ s. d. —	£ s. d. —	1. The annual school income of 1,200*l.* maintains what is called a "Modern" School as well. In *that*, Natural Science is, I fancy, more extensively cultivated. 2. It is difficult to discriminate and say what amount of money is expended on the teaching of the several branches, *e.g.*, my own official salary of 300*l.* may be said to be expended exclusively in the teaching of Classics, and its kindred subjects, History and Geography, &c. The Second Master, whose salary is about 190*l.*, divides his time between Classics and Mathematics. An Assistant Master, with a salary of about 130*l.*, teaches Arithmetic, Physical Science, so far as it can be said to be taught, and assists in French. Torcross, Kingsbridge, July 10, 1871. T. B. Cornish.
—	—	—	The Modern School, in which alone Science is taught, is distinct from the Classical School, and receives 500*l.* per annum from the endowment. No separate charge to pupils is made on account of instruction in Science; and no payment from the endowment, except about 2*l.* per annum to renew chemicals, &c. The only Exhibitions are held from the Classical School.
60 0 0	50 0 0	10 0 0	—
The 215*l.* is spent in giving salaries to two Masters: head, 140*l.*; second, 60*l.*; prizes, 15*l.* Natural Science is taught by an extra Master.			The laboratory has not been used in my time (two years past), nor, I believe, for some years previously. The teaching has been very elementary, and has been under the charge of an additional Master, appointed by the Trustees, and practically independent of me. He is paid by a tax of 5*l.* each on boarders; but as he undertakes other school work, the Natural Science teaching, although it has improved lately, is at a very low ebb and not efficient. I have resigned the School, and, I believe, now a single Head Master is to have the control of all departments, which I hope may result in Natural Science being properly taught. (Signed) John Chambers, M.A., Head Master (St. John's Coll., Camb.).
—	—	—	It is impossible to state separately the amounts expended in teaching Classics and Mathematics, because both subjects are taught by the same Masters. The whole amount expended in teaching Classics and Mathematics averages about 550*l.* Charles G. Hamilton, Head Master.
Impossible to distinguish. All Masters teach in all classes according to their attainments in each.			I am hoping, as soon as I am enabled, by a new scheme, to form a School of Natural Science, with a laboratory and proper apparatus. Meantime regular instruction is given to a selected portion of the school by the Form Masters, from good text books, in certain branches of Natural Science; and these subjects form part of the examination for removes. J. A. Pears, Head Master.
—	—	—	To the Secretary of the Royal Commission on Scientific Instruction and the Advancement of Science. Sir, On attempting to fill up the printed form of inquiry which you were good enough to send me, I found it impossible to adjust any reply regarding the circumstances of this school to the classification of subjects laid down in that form.

I must, therefore, beg to communicate with you through an ordinary letter.

This foundation consists of three independent schools:—

i. The Latin School, over which alone I have any authority (34 boys at present).
ii. The English School (48 boys).
iii. The Girls' School (24 girls).

The last two are Elementary Schools; the first is an English Grammar School, intended to supply a "liberal education."

The total endowment is not far short of 400*l.* a year. The Mistress receives 30*l.* a year and has a residence provided. The English Master has 90*l.* a year and a house: no boarders. The Head Master (*c'est moi*) has 140*l.* a year, a house, and *liberty to take* 20 boarders, *with room for* 13. I have now 11.

In addition to the endowment, the Trustees at present receive capitation fees from my boarders, four Latin day scholars, and two English day scholars, to the amount of 64*l.* a year.

I am allowed 20*l.* a year towards assistance; the English Master 5*l.* (!); and a sum of 5*l.* (!) a year has been allotted to us "towards" the fuel and cleaning of all three schools.

A portion of the endowment is absorbed in repairs, &c., on the estates of the schools, and in the expiation of old sins by the payment of costs incurred by former litigation.

Still, you will learn with surprise that absolutely *no* scientific educational apparatus is provided in these schools *by the Trustees; not so much as a map or a globe*, nor pens, ink, nor black-board; *much less* (to use a slight hyperbole) diagrams or models. The English Master and the Mistress have asked for maps, without avail. The meagre supply in the English School, and the better apparatus of the Latin School, are the property of the Masters.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
DERBY—*cont.*				
Risley—*cont.*				
—	—	—	—	—
Tideswell.				
320*l.*	None.	No time given to Science teaching, but school hours number 27½ per week.	—	None.
DEVON.				
Exeter (Free Grammar School of St. John's Hospital).				
a. School income about 90*l.* *b.* School Exhibitions, about 500*l.*, to Oxford and Cambridge.	Varies from 7 to 12.	About 3 hours.	None hitherto.	None.
Exeter (Hele's).				
Endowment - £300 Payments of scholars - 319 Two Exhibitions of 50*l.* in prospect.	About 60 learning Physical Geography.	One hour and a half by the Masters.	As yet, no Exhibitions have been awarded.	* No.
DORSET.				
Sherborne.				
About 1,100*l.*‡	94	2¾	In the *highest* Forms: Classics - - 8 History and Divinity - - 2 Modern Languages - - 2 Mathematics and Natural Science 4	There is no laboratory, but plans are ready, as soon as the Governing Body is reorganised under scheme.
DURHAM.				
Durham (City), attached to the Cathedral Body.				
18 King's Scholarships of nearly 40*l.* each.	None at present learning practically, about 20 in the Modern Form learning from books.	—	None at present.	None at present.
Darlington.				
200*l.* No Exhibitions.	20, in all about 40.	30	*No Exhibition.* Monthly examinations in elementary subjects, Natural Science, and Mathematics.	None, except two globes.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
—	—	—	Being insufficiently assisted, and having many outgoings, the English Master and myself have too many ages, capacities, and standards of attainment to deal with, for us to attempt much in new studies. In the English School some rudiments of Physical Science may appear in the reading books. In the Latin School, the English classes, numbering 15 boys out of the total of 34, read Tyndall's *Elementary Lessons in Natural Philosophy* for two hours a week generally; but, owing to the variety of subjects of study, even this has to "go to the wall" when a "spurt" is needed in the Euclid; so you may put down my Natural Philosophy lessons at two hours a week for about 27 weeks in the year. No Exhibitions of any kind have ever been paid down here; and none exist on the original foundation, or on that of Dame Elizabeth Gray. It is not for want of will or of appreciation of the importance of Physical Science, nor yet for entire lack of information on my part, that I do so little in this way. For further information allow me to refer you to— Mr. John Stevens, Draycott, Derby, in whose hands, as Clerk of the Trust, the policy of conducting it chiefly lies. I am, Sir, your obedient servant, George F. Grundy, M.A. July 3, 1871. (Brasenose Coll., Oxford). P.S.—In determining a prize for my class, I add up the marks for Tyndall with those for the Euclid.
No division of income. Only one Foundation Master, who receives three fourths of gross income, or 240*l*. Remainder given to poor in doles. John Carillon, Master and Senior Member of the Corporation.			
I cannot apportion the amounts; an extra fee of 2 guineas a year is charged for any branch of Natural Science, and is entirely optional.			Our new scheme from the Endowed Schools' Commissioners will, it is hoped, place Natural Science teaching in a more favoured position. (Signed). H. Newport, M.A., Head Master. School House, 12th July 1871.
†	†	†	* 1. The pupils who wish it can avail themselves of instruction at the Science Classes, conducted at the Museum, which is near the school. † 2. The total expense for instruction of 177 boys in all subjects is 428*l*. per annum, which I am unable to divide for the above subjects. July 8th, 1871. Charles Long, A.C.P., Head Master.
§	§	§	‡ Gross rental returned in 1865 at 1,300*l*. 5*s*. 2*d*. § It is impossible to divide the amounts spent in teaching, as the Natural Science is taught by the regular Mathematical Masters, all three of whom have taken high degrees as Wranglers, and two are Fellows of St. John's, Cambridge. Moreover, one of the *Classical* Masters (who was a Wrangler as well as Chancellor's Medallist) is much interested in Natural Science, and takes a class therein. We shall probably have a "Demonstrator" attached to our laboratory as soon as we can get one built, but propose to keep our *teaching* as at present. Sherborne, July 1, 1871. H. D. Harper, Head Master.
—	—	—	The Dean and Chapter of Durham propose to add a School of Natural Science next year, as soon as the requisite buildings are erected. Henry Holden, D.D., Head Master.
Pupils procure their own books and implements.			No teachers but the two Masters. I shall be most happy to furnish any required information in my power. Eastbourn, Darlington, John Marshall, 3rd July 1871. Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
ESSEX.				
Brentwood.				
1,434*l.* for School and Almshouses. School enjoys about 550*l.* Exhibition of 40*l.*	14	4	—	No.
Chigwell.				
Income about 427*l.* from Charity, 720*l.* from fees.	134, *all.*	12	There are no Exhibitions.	There is a laboratory, a small herbarium, and *good* apparatus.
Dedham.				
Income, 330*l.* 15*s.* 3*d.*; Exhibitions, 79*l.* 0*s.* 1*d.*	14	From 6 to 8.	None.	Large and well-fitted laboratory.
Earl's Colne.				
About 240*l.*	5	30	—	No.
Newport.				
Head Master's stipend, 130*l.* Second Master's stipend, 75*l.*	None.	—	—	—
GLOUCESTER.				
Bristol Grammar School.				
Income - - £1,100 Exhibitions - 120 Scholarships at St. John's College, Oxford - 200	78	10	None.	There is a laboratory in which about 10 of the most advanced pupils work with the Master.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
—	—	—	School House, Brentwood, Sir, July 7th. 1871. I enclose the form but imperfectly filled up. I regret I cannot answer its questions more precisely. The facts are as follow :—1. The Exhibition referred to has only just been founded; no award has yet been made; and no conditions are attached to it in future awards except that in the Founder's will, that it is to be held at Oxford or Cambridge. I presume that if a scholar showed marked proficiency in Science he would be allowed an equal chance with a boy otherwise distinguished. Till the present year no teaching in Science has taken place here. It seems, however, to be the wish of the Endowed Schools' Commissioners that in future at least one branch shall be taught. With a view to meet their wish, I introduced some lessons in Elementary Chemistry and Physiology to the upper boys. The Commissioners are now engaged in preparing our scheme. It is impossible to assign the amount paid for teaching the various subjects. I have four Masters associated with me; we all, except the foreign language Master, take both classical and mathematical work, including arithmetic in that latter term. One takes also the lessons in Science referred to. Believe me, &c. William Quennell, Head Master.
300 0 0	230 0 0	120 0 0	The amounts expended in teaching are all approximate, as I teach some subjects. We take Physiography or Advanced Object Lessons with the first and second Forms, Botany (Henslow's System), Physiology with Marshall's diagrams, and Chemistry with laboratory practice (four hours per week). The Science is taught by a London graduate, an Oxford first class in Science, and myself. It is a compulsory subject, and we are now yearly sending boys up to the Government examinations. H. M. Robinson, M.A., F.R.G.S., M.C.P., July 1st, 1871. Head Master.
200 0 0	100 0 0	50 0 0	The above particulars are given with as much accuracy as, under the circumstances, is possible. The 14 scholars learning Natural Science are members of a practical class, in which the Classics are not taught, so that more time is afforded for the study of Modern Languages, Chemistry, Physics, and other *practical* subjects. In addition to the regular instruction in Science enjoyed by the above 14 scholars, occasional lectures on the subject are given by the Head Master, and by other competent teachers, to the whole school. Gerald T. Lermit, LL.D., Head Master.
—	—	—	—
—	—	—	The boys at the above school are at present receiving almost elementary instruction, as they are for the most part young and generally very backward. James Brown.
It is impossible to fill up these columns, because there are no definite sums set apart for each subject, and certain masters teach both classics and mathematics. The arrangements for teaching Natural Science are described below.			Natural Science has no recognised place in the teaching of the school. Six years ago the Head Master recommended to the Trustees a scheme for its introduction, but the Trustees found themselves unable to provide the necessary funds. A private arrangement has since been made with a Teacher of Natural Science, under which certain rooms are put at his disposal, and he receives and teaches pupils of the school for a fee of 5*s.* a quarter. These fees are paid by the parents of the pupils to the teacher, and neither the Masters nor the Trustees have anything to do with them, the provisions of the "scheme" under which the school is governed forbidding extra fees to be charged for any part of the teaching of the school. Practically Natural Science is an alternative for Latin and Greek Verse Composition, the Head Master excusing such boys as attend the Natural Science Classes from the verse composition of their respective classes. The working of the system is not altogether satisfactory, because the attendance of the pupils at the Science Classes is voluntary; and any exercise of discipline is apt to be followed by the withdrawal of the pupil from the class. At the same time, many of the pupils have gained great advantage from the teaching, and more than half the boys, who would otherwise have been spending their time in acquiring a smattering of Latin and Greek versification, have learned the principles of Chemistry and Physics; and some have made very considerable progress in the knowledge of these subjects. Prizes to the value of 7*l.* have been provided by private gifts, and the Trustees pay an examiner to examine the classes in order to determine these prizes. The Trustees have drawn up a new Scheme for the School, which will enable them to put Natural Science into its proper place as a part of the regular teaching of the school. But it is not certain that the Endowed Schools' Commissioners will accept this scheme. John W. Caldicott, M.A., Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
GLOUCESTER—*cont.*				
Cheltenham.				
Available from endowment for purposes of education and kindred subsidiary objects : 758*l*. 9*s*. Exhibition at Pembroke College. *See* Government Blue Book for Gloucestershire, Vol. ( ).	Routine subjects for half year ending June 1871 : Chemistry - 38 Heat - - 15 Botany and Zoology - 1	6 The masters, however, work very many additional hours at irregular periods, as circumstances may require.	At the last examination held at Pembroke (1869), the candidates were offered the choice of adding certain specified Physical subjects, of which Chemistry was one.	A laboratory, and occasional grants of money for apparatus from the patrons.
Gloucester (the King's or Cathedral School).				
None	About 50.	There is one lesson every Saturday morning for about an hour.	—	None.
Northleach. 568*l*.	15	4 hours	None.	None.
HEREFORD.				
Hereford (attached to the Cathedral). Endowment, 30*l*. (Separate) Scholarships and Exhibitions, 1,000*l*.	—	—	None.	None.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
Head Master Second Foundation Master Third ditto ditto *Senior Commercial Master First Junior Assistant in Junior Commercial room *Second Junior Assistant in Junior Commercial room		£ s. d. 421 15 0 175 2 6 157 11 3 125 0 0 110 0 0 110 0 0	The Masters marked with an asterisk (*) teach Science methodically; the Head Master occasionally. I take the liberty of quoting some of the distinctions gained *in Natural Science*:— *Oxford Local Examinations.* 1859. C. G. Swann, A.A. 1866. H. Crookshanks, A.A. Class II. 1860 { E. J. Alleyne, A.A.† / J. S. Bergheim, A.A. / W. H. Corfield, A.A. 1869 { J. Lane / W. Micklewright } Junior Certificates in Chemistry. 1870. A. Bryant, A.A. Class II. † Prizeman for Chemistry on leaving Woolwich Academy as R.E. *Universities and Public Scholarships.* 1862. A. P. Hurlstone. Physical Science, Class II. London. 1862. R. Guinness. Natural Science, Class II. Cambridge. 1865. W. H. Corfield. Natural Science, Class I. Final Schools, Oxford. 1869. A. W. Davies. Prox. Accessit to Open Scholarship for Natural Science at Magdalene College, Oxford. A. W. Davies. Open Scholarship for Natural Science at Jesus College, Oxford. Cheltenham Grammar School, August 7, 1871. Sir, I have the honour to return the enclosed schedule, and believe it to be correct to the best of my means of information, and remain Your obedient servant, J. N. Lockyer, Esq. Henry M. Jeffery, Head Master.
No such division of expenses.			The Dean and Chapter, who are patrons of the Cathedral School, make no special provision in the way of exhibitions or prizes for Natural Science. Besides the weekly lesson above referred to, we have occasional lectures in Natural Science from the teacher of the Science Classes (under the Science and Art Department, South Kensington), and there is an Examination in some specified subjects (at Midsummer last we had geology and Lardner's Natural Philosophy, first seven chapters) every half year. At Christmas we always have *steam*, with some other subject. The boys work a good deal by themselves out of school hours, in preparation for these examinations. The marks count in with those for other work. (Signed) H. Fowler, Head Master of the King's School, Gloucester.
—	—	—	The whole endowment is divided between the First and Second Masters, viz., for teaching Classics and Mathematics. There is an Exhibition of 60*l.* every fourth year to Pembroke College, Oxford. The examination is mainly classical. There is no provision made for teaching Natural Science. The Head Master has lately taught Astronomy, Acoustics, &c., and the Second Master Chemistry. We feel greatly our need of apparatus. It is impossible to teach our class of lads, mainly sons of farmers and mechanics, without interesting experiments, especially in chemistry. But, above all, we the Masters, feel incompetent. There is need of an *especial Master*. Charles H. Lowry, M.A. Northleach, 3 July 1871. Head Master.
—	—	—	The scholarships and exhibitions are (most of them) under the control of Brasenose College, Oxford, and St. John's College, Cambridge. They are awarded to qualified candidates from Hereford School, after examination in Classics and Mathematics. For particulars respecting Exhibitions, &c., *vide* enclosed paper [here given]. "Twenty-one scholarships and exhibitions belong exclusively to "Hereford school, and are open to all boys there educated. They are filled up from other schools only in default of "qualified candidates from Hereford. Not less than five are vacant every year. "Two scholarships of about 60*l.* per annum, and four scholarships of about 45*l.* per annum, tenable for five years, at Brasenose College, Oxford. "Four Exhibitions of 50*l.* per annum for three years, and eight Exhibitions of 40*l.* per annum for four years, at St. "John's College, Cambridge. "Three school Exhibitions of 50*l.* per annum for three years, tenable at Brasenose, with or without a scholarship. "The school has also a contingent claim to four other scholarships at Brasenose." During the two years of my mastership (and previously, I believe), a course of lectures has been delivered by Mr. G. H. With (Master of the Blue Coat school) in the earlier part of each year. In 1870, Mr. Jeffery (of Cheltenham), who was then holding classes in Hereford in connexion with the Science Department, South Kensington, gave instruction for some weeks at the Cathedral School to two classes. I do not find any demand for this kind of instruction, but hope to make some provision for it shortly. Eric J. S. Rudd, M.A., Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
HEREFORD—*cont.*				
Kington.				
Endowment, 304*l.* 10*s.* Charge for writing, &c., about 45*l.* No Exhibitions.	None.	30	—	—
Lucton.				
Out of income, 300*l.* per annum to Exhibitions, if sufficient candidates.	None.	38, exclusive of exercise times.	None.	No.
HERTS.				
Aldenham.				
(*See* Report of Endowed Schools' Commission.)	None.	—	None.	None.
Berkhampstead.				
Income - 1,500*l.*, 4 Exhibitions of 60*l.* each, 240*l.*	40 boys learning Chemistry.	One hour per week, but there is some work given to the boys to be done out of school.	None; but some marks will probably be given for Chemistry ere long.	No laboratory.
KENT.				
Canterbury.				
No income separate from the Dean and Chapter funds. Gross sum paid to King's scholars and exhibitioners, 753*l.* 6*s.* 8*d.*	92	8	None.	A small laboratory fitted up at our (the Science Master's) expense, and an air pump provided by the Dean and Chapter.
Canterbury (Clergy Orphan School).				
—	None.	—	None.	None.
Faversham.				
Income, 360*l.*, less 80*l.* Two Exhibitions, 60*l.* each.	—	—	—	—

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
—	—	—	There are no pupils sufficiently advanced to be instructed in Natural Science. The Rev. Mr. Bebb, the Second Master, once formed a class in Chemistry, but was obliged to discontinue teaching it. There is no separate sum appropriated to Classics, Mathematics, or Natural Science; the only fee received for many years is 10*s.* 6*d.* per quarter paid to the Second Master for Writing and Arithmetic, and there is a separate charge of 15*s.* per quarter for a few who learn French. J. N. Walsh, M.A., Oxon, Head Master.
—	—	—	The Head Master regrets that, owing to the constitution of the school, he cannot fill up the schedule in a way which would be satisfactory, either to the Royal Commission or to himself. No attention has been given to Natural Science (unless Geography be considered a branch of it), nor could there have been as the school is at present constituted.
—	—	None.	I am utterly opposed to the introduction of what must be, having regard to the number of subjects taught, a mere smattering of Natural Science, whatever is intended by that loose word. Alfred Leeman, M.A., Head Master.
—	—	The Chemistry class does not pay its expenses, in fact it entails a loss of, perhaps, 15*l.* a year or more on the Head Master, but it has been established, (*a*) as being very useful; (*b*) as an attraction to the school.	The Chemistry class seems much appreciated; is a decided advantage to the school, and does not injure the other subjects. But the amount taught is not very much, though boys with a taste for the subject attain more knowledge than might be supposed. E. Bartrum.
No separate fees charged or paid for the different subjects taught.			We have no separate Science Master, the Second Master (Head Mathematical Teacher) and myself (I took first-class honours in Science at Oxford) undertake the entire work. We have a regular scheme of teaching throughout the school. In the Lower School, the two Upper (Arithmetic) Classes go through an elementary year's course of Botany and Physiology (Anatomy) with me. The Fourth Form, through a course of elementary Inorganic Chemistry with the Second Master in the laboratory. The Fifth Form, also with him, go through a course of Physics. He also has a more advanced class of Fifth and Sixth Form boys in Chemistry. In the Sixth Form the boys make their election between German and Science. Those who choose the latter go through a year's course of Geology or more advanced Physiology with me in alternate years. P.S.—The marks in Science, with those in Classics, Mathematics, &c., determine a boy's school rank. (Signed) John Mitchinson, D.C.L., Head Master.
430*l.* on both subjects, but every Master teaches both subjects.		—	—
—	—	—	Sir, Faversham, 8th July 1871. I write in reply to your communication of the 30th ulto., which I return with this. I beg to say that my father, the Rev. Sampson Kingsford, Head Master of the Faversham Grammar School, is incapacitated, through extreme age, from attending to business. My father retired from the active duties of the school about four years ago. He then appointed a Deputy Head Master, who should undertake the sole conduct of the school, his proceedings, however, being subject to my father's approval. The present Deputy Head Master is the Rev. J. Hunt, but he has recently received his dismissal for next quarter day. The endowment of the school is derived from a farm in the neighbouring parish. The farm is at present let for 360*l.* a year, which sum is paid to the Trustees of the school. Out of this sum the Trustees retain 80*l.* to meet the cost of improvements on the farm and other expenses; and they hand over to my father 280*l.* a year. From the 280*l.* aforesaid my father pays the Deputy Head Master 100*l.* a year, and 5*l.* a year to the portress of the school. About 30 years ago a gentleman named Henry Wreight died at Faversham, leaving about 100,000*l.* for the benefit of the town. Some years ago the Trustees of this bequest agreed, under certain conditions, to award two Exhibitions of 60*l.* each for three years at Oxford or Cambridge, to boys trained on the foundation of the Faversham Grammar School qualified to enter the University. The only Exhibition of this kind that has been hitherto awarded, was given last year to Mr. Benjamin Snell, of Trinity College, Cambridge. In the past half year the number of scholars in the school was between 30 and 40. The Deputy Head Master has been assisted by one or two other masters, according to the requirements of the school. The masters give instruction to the pupils for six hours a day on four days of the week, and for four hours a day on two days of the week, being the half holidays. The instruction given is that of the usual kind in Classics, Mathematics, Foreign Languages, &c. Natural Science is taught amongst other things, but no particular stress is laid upon it, and there is no laboratory or other agency of that kind. From these particulars you will, I trust, be able to fill up your paper with more certainty than I can. I beg to say that I have nothing to do with the school, and merely write on behalf of my father. I have, &c. To J. Norman Lockyer, Esq. Philip Kingsford, Clergyman.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
KENT—*cont.*				
Lewisham, for hundred of Blackheath.				
—	—	There are two lessons a week in text books of Science, and it forms part of the regular school work.		
Rochester (Cathedral School).				
None.	None in the school.	None given by masters except in Mechanics and Dynamics, &c., as portions of mixed Mathematics.	No examination for exhibitions of any kind.	None at all.
Rochester.				
548*l.* as returned to Schools' Inquiry Commission.	—	—	—	—
Tonbridge.				
Income about 2,643*l.* (net). Four exhibitions annually of 100*l.* each.	None.	None.	None.	None.
LANCASTER.				
Blackrod (B'rod Free G. School).				
—	9	32½	—	None.
Bolton-le-Moors (Grammar School).				
—	—	—	—	—
Burnley.				
There are none of any kind.	About 40.	2 hours.	Due weight would be assigned if there were Exhibitions.	Strictly speaking there is no laboratory, but there are numerous chemicals and instruments belonging to the school.
Clitheroe, in Parish of Whalley.				
Income of school from endowment, about 300*l.* Two Exhibitions, each 40*l.* per annum.	All the Senior Forms, about 20 in number.	No regular stated hours, but a lesson per week.	The Exhibitions are awarded to the boy of highest standing, not by special subjects.	None attaching to the school. All such property belongs to the Head Master, who has good philosophic apparatus, and uses it to illustrate the school lessons.

AMOUNT EXPENDED IN TEACHING.			REMARKS.
Classics.	Mathematics.	Natural Science.	
100*l.* is assigned by the Chancery Scheme as Master's salary.			Instruction scheme, Art. 22, comprises—Religion, Greek, Latin, French, English, Mathematics, Arithmetic, History, Geography, and such other branches as may to the Governors seem expedient; but the funds are too small to allow any Scientific Teaching worth the name, though I should much wish it, and I think here specially it would be valued. THOMAS BRAMLEY, M.A., Oxon, Head Master.
£150 100 60 30 £340		None in the school.	Five pupils of the school were learning Chemistry last half-year (ending July 20, 1871), but privately and from a teacher in the town: Classics and Mathematics are taught by the same masters. The Dean and Chapter, who are governors of the school, do not recognise competitive examination for any scholarship or exhibition in their gift. ROBERT WHISTIN, M.A., Head Master.
—	—	—	Natural Science is not taught in this school, and the amount expended in teaching cannot be arranged under heads as "Classics" and "Mathematics." The Second Master teaches the lower portion of the school all that the boys learn; the Head Master all that the elder boys are taught. The boys enter the school at seven years of age, "reading" being the sole qualification for admission. If they reach the Head Master's school before 12, they then begin Latin. The boys leave at 15, having then gone through one or two books of Cæsar; in some cases six books of Euclid and Todhunter's *Algebra* for beginners; Colenso's *Arithmetic*, Geography (General), English History; Cornwell's English Grammar; Merlet's *French Accidence*, and a work of some French author.
Cannot be separated.		None.	We are waiting for the New Scheme before we commence Natural Science. At present we could not enforce attendance upon the Classes for Natural Science if we had them, nor make any charge in the way of payment.
—	—	—	This being a mining and manufacturing district, the children generally are taken from school at an early age to be employed in coal mines, cotton mills, bleach works, &c. Master's salary, 90*l.* per annum. July 15, 1871. RD. SMITHSON, Master.
—	—	—	This is for the most part a free school, and there is no special instruction in Science, nor is it required, as such instruction may be obtained at the evening classes, both at the Church Institute and the Mechanics' Institution, for a very small payment. DISTON S. HODGSON, M.A., Bolton, July 5, 1871. Head Master.
All the subjects mentioned in the Middle Class Schools Commissioners' Report are taught for 1*l.* 1*s.* per quarter.		Each boy pays 1*d.* per lecture to the Science Master.	The Head Master has the honour to inform the Commissioners that for many years past *every* encouragement has been given by all the three Masters of this Institution to induce the boys to try and excel in Science. For several years past the more advanced pupils have presented themselves as candidates for distinction at the Annual Examinations held here by representatives of the Science and Art Department, South Kensington. The Second Master, an F.R.A.S., has used great exertions, and has always successfully taught a class in Geology. (Signed) JAMES BUTLER, D.C.L., Oxon, Head Master.
There being no separate accounts on these heads, the questions do not admit of answer.			Text book in *Natural Science*, Harding's Lardner, but we view Natural Science chiefly as a branch of Mathematical Science, and Todhunter's *Mechanics*, Tait's *Practical Mechanics*, form a part of the Senior Form course of study. EDW. BODEN, M.A. (Cambridge), Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
LANCASTER—*cont.*				
Great Crosby.				
We have no Exhibitions. Income, 950*l.* (mixed endowment), of which 400*l.* nearly is applied to the school.	30 boys learn Physical Geography. Four have lately begun Mechanics.	About two hours to Geography, and one hour to Mechanics.	—	None.
Hutton, in the Parish of Penwortham.				
Nil.	None.	—	—	—
Manchester.				
Endowment - £2,500 Exhibitions and Scholarships given at the school:— 1 Rickards' Scholarship, value - £50 3 Brackenbury „ 160 4 Shakespeare „ 54 8 £264 These Exhibitions have all been founded, the first by a Trustee, C. H. Rickards, Esq., and the remaining three by Miss Brackenbury, within the last year and a half. In addition to the money thus given, 23,000*l.* has been subscribed by the public for the erection of new buildings, E. R. Langworthy, Esq., heading the subscription list by a sum of 10,000*l.* There are close Scholarships and Exhibitions attached to the school, 10 at Brasenose College, Oxford, and four at St. John's College, Cambridge. The following are the particulars respecting the Scholarships, Exhibitions, Prizes, &c.:—	150. 120 of these make Physical Science and Mathematics their main study, and I think with success. I give below a list of distinctions gained at the Universities and elsewhere during the years ending Midsummer 1870 and 1871, in Physical Science, Mathematics, and Drawing. The same amount of labour given to Physical Science gains a scholarship much more certainly than if given to classics. I had at one time submitted a much larger number of boys to scientific instruction, but I find that the average boy, if forced to study many subjects, makes progress with none.	50 hours (*i.e.*) the entire time of two Masters. An additional Master in Physical Science it is contemplated should be engaged at Christmas, when the new laboratory is completed.	One Brackenbury Exhibition, vacant once in three years, is awarded exclusively for Natural Science, and another for Mathematics, (*i.e.*) half the School exhibitions are given to Mathematics and Physical Science. The close Scholarships and Exhibitions are, I believe, given without reference to Natural Science, but should a boy of distinct promise in Physical Science offer himself at Brasenose College, the authorities would, I have no doubt, elect him.	There is at present a laboratory where 30 scholars can work at a time, which cost 400*l.* to fit up, and which takes 100*l.* a year for working expenses. The Trustees have begun to fit up an additional laboratory at an estimated cost of 800*l.*, where more advanced scholars can be instructed in volumetric and quantitative analysis. Two rooms are set apart for instruction in Physics, and 300*l.* has within the last two years and a half been spent in the purchase of physical apparatus.

Somerset Scholarships.—Two or more scholarships at Brasenose College, Oxford, tenable for five years, and varying in annual value from 50*l.* to 60*l.*, fall vacant every year. They may be held along with open scholarships of the College. No boy is eligible who has been less than two years at the school.

Somerset Exhibitions.—One Exhibition at St. John's College, Cambridge, tenable for three years, and of the annual value of 50*l.*, falls vacant every year, with an additional one every third year. They may be held with sizarships, or open exhibitions, or scholarships of the College. No boy is eligible who has been less than two years at school.

Rickards' Scholarship.—In 1869 a sum of money was subscribed by the inhabitants of Manchester, in recognition of the public services of Charles H. Rickards, Esq., formerly a Scholar and now a Trustee of the school. With the funds thus raised Mr. Rickards has established a scholarship of 50*l.*, which was awarded for the first time at the Michaelmas examination.

Brackenbury Scholarships.—Miss Brackenbury has presented 4,000*l.* to be appropriated to the foundation of three exhibitions or scholarships at the University of Oxford, to be held for three years by the best scholar of the year in Classics, Mathematics, or Physical Science. The Mathematical Exhibition was awarded for the first time at the Michaelmas examination.

Shakespeare Scholarships.—These scholarships were founded to encourage the study of the English language and literature. They are tenable for two years, and are four in number—two of 20*l.*, and two of 7*l.* a year. The competition is open to all boys under 17 who have been a full year at the school, and have passed a preliminary examination in Elementary Classics and Mathematics.

Owens College Exhibitions.—Three Exhibitions were founded in 1861 for the purpose of enabling the holders to continue their studies at Owens College after leaving the school. One Exhibition, tenable for three years, and worth about 14*l.* a year, is offered for competition annually.

Lawson Medals.—Two medals, one gold, of the value of 18*l.*, the other silver, in memory of Charles Lawson, M.A., formerly High Master, are awarded for the highest and second place respectively, in Classics, at the Midsummer examination.

Thompson Prize.—A book prize, of the value of 4*l.*, in memory of Richard Thompson, M.A., formerly Second Master, is awarded at Midsummer for proficiency in History. Any boy below the High Master's Form may compete.

Royal Geographical Society's Medals.—These medals are offered for general competition among the boys of the principal schools in Great Britain, Manchester School being one of those selected.

Early English Text Society's Prize.—This is an annual prize given for the encouragement of the study of early English. The competition is open to all boys in the school.

AMOUNT EXPENDED IN TEACHING.			REMARKS.
Classics.	Mathematics.	Natural Science.	
—	—	—	As our school consists of 73 boys of all ages, from 8 to 16, and as there are only two Masters (besides a French Master, who comes twice a week for two hours) to teach all the subjects, it is impossible to make any way in the direct subjects of Natural Science. We are, however, hopeful of prosecuting them more extensively when the Endowed Schools' Act shall have removed certain restrictions which at present clog the school. As we have no special Masters for subjects, it is not possible to answer as to the "amount expended in teaching." SAM. C. ARMOUR, B.A., Head Master.
—	—	—	The funds of this endowment are expended in the maintenance of a *Free* Grammar School at Hutton, in the centre of the parish, for the better accommodation of the whole parish, to the children of the inhabitants of which it is open, and who learn the Classics only if they desire it. And besides the Grammar School at Hutton, separate *Free* Schools (Elementary) for boys, and Schools are maintained in each of the following townships of the parish, viz., Penwortham, Farington, and Longton; and a mixed school for boys and girls in the township of Howick. There is also an elementary school for girls at Hutton. Hutton, Preston, July 3, 1871. JOHN KETTON, M.A., Head Master.
The gross aggregate of salaries amounts to - - 4,600*l.* a year. The salaries of the Mathematical Teachers - 860*l.* „ The Science Teachers - 500*l.* „ And the Drawing Master - 200*l.* „			It is impossible to separate the cost of the classical teaching; the same masters who teach classics teach English subjects, Writing, and a large part of the French; the salary of the High Master, who has the general superintendence of the school, is of course included in the aggregate salaries. Since the introduction of Natural Science into the school our balance sheet exhibits a constant deficit. I calculate the Science teaching entails an annual loss of 300*l.* Honours gained by scholars in Physical Science, Mathematics, and Drawing during the last two years have been, Midsummer 1869 to Midsummer 1870; Midsummer 1870 to Midsummer 1871. *Oxford and Cambridge.*—1 Mathematical Fellowship; 1 Wrangler; 1 Senior Optime; 3 Open Mathematical Scholarships; 2 Open Physical Science Scholarships; 2 Close Scholarships (chiefly for Mathematics); 1 First Class in Mathematics; 1 First Class in Natural Science; 1 (partly Mathematical) Fellowship; 2 Open Mathematical Scholarships; 4 Open Physical Science Scholarships. *University of London.*—7 Matriculations; 12 Matriculations; 1 Board School, London. *Department of Science and Art.* *Science.*—37 Prizes; 256 passes; 85 prizes; 335 passes. *Art.*—5 Higher Grade prizes; 34 Second Grade prizes; 152 Second Grade passes; 7 Higher Grade prizes; 38 Second Grade prizes; 171 Second Grade passes. July 31st, 1871. FRED. W. WALKER, High Master. [See also an additional Report in reply to Secretary's Letter of 27th of September 1872.—Appendix III., p. 179.]

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
LANCASHIRE—*cont.*				
Rivington. £500	—	25	—	—
Warrington. Gross endowment - £550 Capitation fees - 400 £950 Net amount available for Masters' stipends - - £830 N.B. *No* Exhibitions.	40	2	—	No.
Wigan. Endowment, about 280*l.* Exhibitions, none.	5 boys learn Chemistry	1¼ hours.	—	No.
LEICESTER.				
Ashby-de-la-Zouch. 1,037*l.*	None.	None.	None.	None.
Loughborough. —	—	—	—	—
Market Bosworth. 4 Exhibitions, 80*l.* a year each.	None.	26 in school, more (as required) out of school.	None.	No.
LINCOLN.				
Alford "Royal Grammar" School. Income, about 280*l.* There is one Fellowship, and there are two Scholarships at Magdalene College, Cambridge, but not made use of for five years.	Not any.	30 hours, by two Masters.	Natural Science and Modern Languages, especially French, desired.	None.
Caistor. 305*l.*	—	—	—	—
Donington. 800*l.* or 900*l.*; Exhibitions, 75*l.*	—	—	—	—
Heighington. 154*l.* 12*s.* 0*d.* to Head Master; 66*l.* to usher; no Exhibitions.	—	Each Master gives 30 hours.	—	No.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d. 145 0 0	£ s. d. *—	£ s. d. —	* These two subjects are both taught by the Head Master, together with other subjects, such as English Grammar, History, &c. SEPTIMUS TEBOY, B.A., Head Master.
350 0 0	90 0 0	10 0 0	The above is a very rough approximation, it being impossible to calculate with accuracy the exact amount of time devoted to each subject specified above by each Master. O. H. CARY, Head Master.
—	—	30 0 0	No Master receives a salary for teaching Classics alone, or Mathematics alone. Each Master has a variety of duties to perform. The teacher of Chemistry is paid by the Head Master out of his own income. The Governors contribute nothing.
[Latin.] 320 0 0	[English.] 220 0 0	—	Several pupils attend Evening Science Classes in connexion with the Department of Science and Art, taught by the Head Master of our English Department.
—	—	—	We have no Science taught in this school at all, not for want of *will*, but for want of *means*, and there will be none until the Endowed Schools' Commissioners have helped us out of our difficulties. J. WALLACE, M.A., Head Master.
—	—	—	I have no accurate or formal knowledge of the income of the school, or of the sums expended yearly on instruction, &c. This belongs wholly to the Patron, and Governors or Trustees, who have the sole charge and management of the property and income. The school consists of an Upper or Latin School for Boys going either to Oxford or Cambridge, but chiefly they will go to Cambridge, as the school is connected with Emmanuel College. The English School is for the instruction of the boys of Bosworth and its "chapelries," the sons of tradesmen, farmers, labourers, and the like. "Natural Science" forms no part of the education of boys of either class. GEORGE JOHN DAVIE, M.A., Clerk in Holy Orders, Head Master. July 4, 1871.
270*l.* Amount expended in Classics, Mathematics, and English subjects of education, and partly in French.			The Head Master has been but recently appointed; he has delayed sending this report, as he wished to hold inquiries in the neighbourhood. There seems to be every desire in this neighbourhood to have Natural Science and French (and German if possible) introduced. This *I have recommended* in my report to the School Commissioners. H. SEYMOUR ROBERTS, LL.D., Of the University of Cambridge, Head Master. Royal Grammar School, Alford, Lincolnshire, 20 July 1871.
—	—	—	Up to the present time Natural Science has not been taught in the Caistor Grammar School. The teaching has been confined to Classics, Mathematics, and the ordinary subjects of a commercial education. ANTHONY BOWER, Head Master.
—	—	—	The annual income here applied to education is from 800*l.* to 900*l.* a year; 75*l.* expended in Exhibitions. This endowment supports four schools, viz., Grammar, Lower Boys', Girls', and Infants' schools. In the Grammar School (40 boys) the lessons on Mechanics are illustrated by Willis's apparatus and models. A microscope, a magic lantern with lime light and a microscope adapted to it, a geological cabinet, some chemical apparatus, an air-pump, electrical apparatus, diagrams, &c., are used from time to time as we need them; but it would be difficult to give statistics as to hours, &c., because we have no "Natural Science Master," but introduce apparatus to illustrate lessons as occasion may require. W. J. R. CONSTABLE, LL.D., Head Master.
—	—	—	By the most recent scheme of the Trustees it is ordered, "That the instruction given in the school include all the branches of a good English education, viz., the Holy Scriptures and the Prayer Book, Grammar, Analysis, Geography, English History, Arithmetic; and that Latin be taught to any boy whose parents express their desire to that effect in writing." The boys are all of the labouring class, and there are at the present time no Latin scholars.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
LINCOLN—*cont.*				
Humberstone.				
—	—		—	—
Lincoln.				
From all sources and fees, 339*l*. Exhibitions: two given *at present* by the Governors, of 50*l*. for three years.	Varies from 10 to 30.	2	None.	A small collection of chemical and mechanical apparatus and diagrams.
Louth.				
—	—		—	—
Stamford (Radcliffe's Free Grammar School).				
—	—	—		—
MIDDLESEX.				
Milk Street, Cheapside, E.C. (City of London School.)				
Income from fees, about - - £6,000 Scholarships and Exhibitions, about - - 1,800 £7,800	All the boys in the School. Average number for last 10 years, 642.	Six divisions. Each division one lecture per week of 1 hour and 1¼ hours.	Proportion:— Classics - - 1 Mathematics - 1 Natural Science $\frac{1}{3}$ There are 28 Scholarships and Exhibitions, in competing for 21 of which the candidate is examined in Natural Science; the seven others having been founded for specific objects.	Laboratory very inconvenient. One of the class rooms is used by the Practical Class, which assembles two hours per week, and consists of 27 boys, the best three boys from each of the first nine classes, the total classes being 12. For Science Lectures, the 12 classes are arranged into six divisions.
City of London, St. Lawrence, Jewry (Foundation of Mrs. Elizabeth Smith).				
Annual value, about 380*l*.	None.	None.	None.	None.
Edmonton (Latymer's School).				
About 500*l*.	20	1 hour.	—	No laboratory. The necessary apparatus and reagents for an elementary knowledge of Chemistry.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
		£ s. d.	
—	—	—	Great Grimsby, 5 July 1871. Sir, Matthew Humberstone's Charity. The Head Master of the Humberstone School has handed me your letter to him of the 30th ulto. The scholars who attend the school are compelled to leave as they attain the age of 14 years. No Natural Science (as such) is taught in the school. I have the honour to be, &c., Robert Stephenson, Clerk to the Trustees.
?	?	Don't know; it is mixed up with other teaching.	It is not very possible to answer the above questions categorically in regard to a school like this. We have taught Science here for 12 years or so. It has been Chemistry chiefly, but of late chiefly Mechanics. J. F.
—	—	—	Sir, The Lodge, Louth, 15th August 1871. On my return from the continent, I have found your circular dated 30th June, in reply to which I have the honour to acquaint you that Natural Science is not at present taught in Louth Grammar School, and beg to remain, Sir, Your obedient servant, Geo. C. Hodgkinson, Head Master
—	—	—	The work done in this school comprises the usual course of Classics and Mathematics, preparatory to entrance at the Universities; it further involves instruction in the Scriptures, History, Geography, Writing, and Arithmetic. (Signed) F. E. Gretton Head Master. July 1st, 1871.
Senior Department. Mathematics, Classics, and English, 2,980*l.* (nearly).	Junior Department. Arithmetic and English, 1,170*l.* (nearly).	215 0 0	—— [See also additional Reports in Replies to Secretary's Letters of 22nd of July 1870, and 27th of September 1872.—Appendix III., pp. 98–103, and pp. 138–140.]
—	—	—	There is no school—no Master. Under a scheme sanctioned by the Court of Chancery, the whole income is expended in giving Exhibitions to the sons of the ratepayers, elected by the Vestry, who must go either to University College School, the City of London School, or King's College School. The Treasurer pays the school bills of each boy so elected up to 20*l.* In 1869–70, there were seven boys at University College School, and 10 at the City of London School. I have no returns yet for 1870–71. The answers to this inquiry will, therefore, be included in returns from the two schools last mentioned. B. M. Cowie, Vicar of St. Lawrence, Jewry, and Rector of St. Mary Magdalen, Milk Street. Gresham College, 28, Gresham Street, July 2, 1871.
—	—	—	This school is worked by a scheme established by the Court of Chancery in 1869. By quoting article 29 of this scheme, the Science Commission will perceive that general provision is made for instruction in Science at the discretion of the Trustees. Article 29, page 17.—"The secular instruction in the First Branch of the School shall comprise, besides Reading, "Writing, Spelling, Grammar, Arithmetic, and General History and Geography, also Algebra and Mathematics, "the Latin and French languages, and Drawing and Designing, and such subjects of Physical Science and Useful "Knowledge as shall from time to time be directed or authorised by the Trustees." Charles Vincent Dolbé, M.A., LL.B., (Clerk in Holy Orders), Head Master. 16 August 1871.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
MIDDLESEX—*cont.*				
Enfield.				
209*l.* 11*s.* 4*d.*	About 40 of a very elementary character.	26	None.	Nothing.
Hammersmith.				
700*l.* income; 15*l.* Exhibition.	—	30	—	—
Highgate, N.				
This varies, and is in the hands of the Governing Body. There is always one, and sometimes there are two exhibitions, given for proficiency in *Classics* and *Mathematics*.	None daily; but some occasionally, by a course of lectures.	Occasional lectures to those who wish it in Chemistry.	None at present, except as to Mathematics generally.	None whatever.
Westminster (St. Peter's College).				
Corporate income, 3,700*l.* Tuition fees, about 4,300*l.* School Exhibitions, 200*l.*	47 (out of 185).	1¼ hours.	Hardly any at all.	Models of mechanical powers, celestial globe, telescope.
Whitechapel, Leman St., E.				
* Income: *see* below under "Remarks." No Exhibitions.	40	3 hours.	Prizes are given at the Midsummer examinations. Science teaching has every encouragement. No Exhibitions.	Yes.
MONMOUTH.				
Monmouth.				
Gross income about 2,800*l.* Income of total number of Masters from "Income of Foundation," 1,210*l.* Exhibitions, three of 50*l.*, one of 60*l.* One of these confined to pupil distinguishing himself in Physical Science.	40	30 For Natural Philosophy, 2½.	One Exhibition of 50*l.*, confined to pupil distinguished in Physical Science.	No laboratory, one contemplated. Some amount of apparatus about to be obtained immediately.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
No division is made of the salary for any special subject.			This is a free school governed by an old useless scheme; so long as this incumbrance remains nothing can be done. The income is from land, and capable of augmentation. Under a new scheme, with capitation fees, the school would do useful work. Twenty-three years' experience has convinced me that the *free* instruction is not valued by the parents, and is a positive block to any improved course. Chas. Chambers.
Cannot be stated separately.		Nil.	—
400*l*. per annum is *all* paid for teaching.			The Head Master has endeavoured to make Chemistry a part of the regular school teaching for all boys whose friends wished them to learn. These have been very few; only those looking to Matriculation at the University of London for a medical career. There is no endowment for a teacher, and he has always had to pay more to a lecturer than he received; add to this, the lecturer has always felt the want of a laboratory. Under these circumstances, the Head Master generally suggests that students of this class should go to London for lectures out of school hours, where the best lecturers and appliances are to be obtained. He generally finds those succeed best who finish their school course *first*. J. B. Dyne, D.D., 5 July 1871. Head Master.
Divinity, Classics, History, Geography, Modern Languages with English, 3,400*l*.	900*l*.		An extract from the regulations sent for approval to the Special Commissioners of the Public Schools included in the Act of 1868 is enclosed, which will show what is intended. [Given below.] At present there is no space for extension. There are 40 Foundation Scholarships, which are not called Exhibitions, but perhaps would be intended to be included under that head in the column above. The Mathematical Masters teach Practical Mechanics and Astronomy, which are the only branches of Natural Science at present attempted. The Classical Masters teach a multitude of other things, as noted above; so that it is not possible to fill up the three columns as printed; and 1,260*l*. of the tuition fees (col. 1) is paid from the corporate income. I request, therefore, that the figures above given may not be included in a table as representing what they do not in fact represent.

Regulations for Westminster School, framed by the Governors.

" *School Instruction.*

" 1. The instruction given in the school shall include Religious teaching, Classics, Mathematics, *Natural Science* (*so far as practicable at present*), French, or German for boys well advanced in French, English, History, Geography, and likewise either Drawing or Music, at the option of the parents, the Head Master having the power of exempting any boy, with the consent of his parent, from learning Drawing or Music, if he think it desirable so to do in the special case.

" 2. Further arrangements shall be made for teaching Natural Science when additional space may become available.

" 3. The representation of a Latin Play by the Scholars of the Foundation at Christmas shall continue as heretofore.

" *Number, Position, and Payment of Masters.*

" 1. The number of Masters shall be so regulated that there may be not less than one Classical or General Form Master for every 30 boys, and one Mathematical or Natural Science Master for every 75 boys. All such Assistant Masters shall be on the regular staff of the school, and shall devote (if required) their whole time to its service. Masters shall also be appointed for Drawing and Music, and for Modern Languages, so far as may be required for efficient instruction in such subjects, beyond what the aforesaid Assistant Masters are competent to undertake."

[See also additional Reports in Replies to Secretary's Letters of 22nd July 1870, and the 27th September 1872. —Appendix III., pp. 94, and 130, 131.] Chas. B. Scott, Head Master.

Classics.	Mathematics.	Natural Science.	Remarks.
—	—	—	* This school is endowed in the following manner:—A certain proportion of the salaries of the Masters, as well as the keeping up of the establishment, is paid out of the surplus income of the Whitechapel parish estates. Arrangements are now made to give instruction in all the classes of the Upper School. We have a good supply of instruments for Chemistry, Electricity, Magnetism, Light, and Heat. The Trustees are exceedingly liberal in this way; I have only to state what I want; as far as funds go I am supplied. To encourage further study in Natural Science, the Trustees have allowed the old scholars to found a Library and Scientific Institution. I enclose you a copy of the rules. The lectures, all by old pupils, are solid and good. Science in the classes stands on the same footing as Latin, Mathematics, and Modern Languages, *i.e.*, an equal number of marks are given to each. *See* enclosed papers. Charles Judd, Head Master.
Great difficulty to obtain a Master who knows anything about teaching Science. A good practical man would be very expensive when employed at a single establishment.			The Head Master teaches both Mathematics and Classics, and receives 200*l*. per annum from school endowment. The Assistant Master for Classics receives 180*l*. ditto. The Assistant Master for Mathematics teaches also Junior Classics and Natural Philosophy, and receives 150*l*. ditto. C. M. Roberts, B.D., Head Master, July 5th, 1871. Late scholar of St. John's Coll., Cambridge.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
NORFOLK. **North Walsham.** About 290*l.*	None.	—	—	—
Thetford. No Exhibitions. This is a mixed charity; about 230*l.* is spent on the school.	None.	—	—	None.
Yarmouth. About 260*l.*; no Exhibitions.	None.	None.	—	None, and none obtainable in the town.
NORTHAMPTON. **Northampton.** 360*l.*	36	One.	No Exhibitions.	None.
Oundle. Grocers' Company, *1057*l.* 10*s.* 0*d.* Parents' entrance and school fees, 210*l.* 13*s.* 0*d.* Exhibitions, 75*l.*	None. Postponed till it be seen what the Commissioners will do.	†31.	None.	‡None.
NORTHUMBERLAND. **Haydon Bridge, in the Parish of Warden.** About 900*l.* (No Exhibitions.)	None.	About 30 in other subjects, but none in Natural Science.	There are no Exhibitions.	None.
NOTTINGHAM. **East Retford.** Value of income about 500*l.*; Exhibition, none.	None.	29	—	None.
OXFORD. **Magdalen College, Oxford.** Silver medal, value 1*l.* 10*s.**	13	Masters give 14 hours, boys have each 5.†	Our stimulus is given by University Scholarships.	A chemical laboratory, and mehanical room.
RUTLAND. **Oakham.** —	—	—	—	—

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
140*l.*	—	—	By the deed of endowment provision is made for the free instruction of 40 boys in Religion and Classics by a Master and usher. No usher has been appointed for many years by the Trustees, and the Master has been allowed to receive a capitation fee of 8*l.* in the case of each boy learning Mathemathics, Arithmetic, Writing, History, and Geography. The Master's annual stipend from the income is 140*l.* The surplus has been allowed to accumulate for many years. THOS. DRY, Master.
—	—	—	The income is expended in teaching English and the Classics when required. There is no separate amount spent on each. Two masters :— ALFRED FOWLER SMITH, M.A., Cantab, Head Master, 130*l.* John Henry Gates, M.C.P., Usher, 100*l.*
From fees and endowment about 1,130*l.*		Nil.	It is impossible to make a separate return for Classical and Mathematical teaching. I consider the absence of instruction in Natural Science a great defect in our system, but I trust that when we are settled in our permanent buildings we shall supply this want. There is no encouragement for boys to learn Chemistry, as there is no laboratory. Our site provides ample room for building one. Difficulties must be expected on account of the obstructive spirit of one or two of the older Trustees, and the dilatoriness and circumlocution of the Charity Commissioners. School House, Great Yarmouth, 1 July 1871. JOHN JAMES RAVEN, B.D., Head Master.
No separate Masters.		—	I am very anxious to introduce the teaching of Natural Science more largely into the school; but there are no funds for apparatus, or for a special master. W. H. KEELING, M.A., Head Master.
575*l.* French and German, 100*l.*	410*l.*	—	* Besides the above sum, the Company paid in 1870 for repairs of school house and master's residence, retaining the bills and receipts; I cannot, therefore, mention the amount. They also paid 115*l.* 5*s.* 6*d.* for rates and taxes, school fuel, cricket club and athletic sports, do. examiners' fees and book prizes. Except the original 41*l.* 4*s.* 0*d.*, and the 210*l.* 13*s.* 0*d.* paid by parents for instruction in Greek and Latin, Mathematics, French, German, and the usual English course, viz., Geography, History, Religious Knowledge, &c., all other payments, I am informed, are voluntary gifts on the part of the Company, and may be withdrawn by them at any time. † Including rather more than one hour on Sunday mornings for scriptural teaching; being optional with day boys. ‡ Estimates and a plan were forwarded to Grocers' Hall, April 1870, for pulling down old buildings attached to the master's residence, and erecting Science class-rooms, a laboratory, museum, &c., but were laid aside till it should be seen how the Commissioners propose to deal with the endowments. There can be no doubt as to their urgent need and importance. J. F. STANSBURY, D.D., Head Master.
275 0 0	Nothing expended under this name. About 350*l.* is paid for teaching in the English Schools, Arithmetic being one of the subjects taught.	—	The foundation is twofold :— I. A "Grammar School" with (at present) one foundationer and the Head Master's boarders; and II. An "English School" numerously attended, and nothing differing from an ordinary National or Elementary School, the children leaving at an early age (some even at 10 years old) to go to work. W. L. PENDERED.
Head Master's stipend - - £150 Second do. - 100 French and German 100		—	It would be very desirable that Natural Science be taught in this school. The present Head Master (only recently appointed) is very anxious to form a class for this subject, and hopes that attention may be drawn to it when the Commissioners reorganise the school; and the sooner this is done the better for the interests of all parties. F. R. PENTREATH, M.A., Head Master.
1,000 0 0‡	250 0 0	113 0 0	* The only endowment, practically, is in buildings, which are excellent. † Boys often attend University lectures; these are *sometimes* paid for. ‡ If the boarding profit be given, please at least double the Classical. Time is given to Applied Mathematics, not here accounted for, and Drawing is taught to about 14. July 5, 1871. (Signed) R. H. HILL, D.C.L., Head Master.
—	—	—	There is no regular instruction in Natural Science. Lectures are occasionally given, and the boys are encouraged in any efforts they may make voluntarily; but as the school is small and there is no laboratory or other aid, it is not thought advisable to fritter away time on what would be only learning Science by rote. No separate sums are devoted to teaching distinct subjects. Classics, Mathematics, English, &c., being all included in the regular school routine. WM. S. WOOD, D.D., Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
RUTLAND—*cont.* **Uppingham.** Sums spent by the Trust: Head Master's salary - £150 0 Usher's do. - 120 0 Exhibitions - 420 0 Library - 5 0 Prizes - 7 10 £702 10 Repairs, a small sum. Between 700*l.* and 800*l.* spent on the foundation.	Six pupils in Chemistry.	From three to six hours.	None.	A small museum set up by me.
SALOP. **Ludlow.** Three Exhibitions of 50*l.* each.	—	—	—	—
Newport. —	14	2	None.	None.
Oswestry. One Exhibition.	—	—	—	—
Wem. Gross income, 240*l.* Two Exhibitions to Christ Church, Oxford, of 60*l.* each.	—	—	—	—
Whitchurch. Gross income, 507*l.* No Exhibitions.	None.	—	—	—
SOMERSET. **Bruton.** 420*l.* Two Exhibitions at 30*l.*, tenable for three years.	14	33	Exhibitions given for general or special merit.	Small apparatus.
Ilminster. About 860*l.*	50	1½	None.	Small.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
—	—	—	Classics and Mathematics are taught as regular school work throughout the schools; there is no separate fee for tuition yet, and if there were, it would not fairly represent the matter, for reasons too long to be stated here. The terms for everything are 70*l.* per annum; this covers the boarding fees and tuition in Classics and Mathematics. Besides this, about 500*l.* per annum is received as payment for extra mathematical teaching, and about 50*l.* for the Chemistry lessons. The Foundation gives towards the educational expenses for the school 282*l.* 10*s.* per annum, and one house. The whole of the school system is carried on on a basis established by me since the year 1853, at my own risk originally, and is, as far as it goes, self-supporting. The Foundation, practically, does nothing for it. Some years ago I made great efforts to set on foot voluntary classes in Natural Science on the same footing as our other supplementary subjects, but utterly without success; no boys would learn. There are 320 boarders in the school now. EDWARD THRING.
—	—	—	We have no data from which to furnish replies to these questions, but are happy to furnish such information as we have applicable to the matter. The income of the school has varied with its requirements, being part of a general income available to many charities, of which the school is one. The Exhibitions are three in number, tenable for three years, of 50*l.* annual value. The holders may matriculate at Oxford, Cambridge, or Durham. There are no facilities for teaching Natural Science, in the way of laboratory or apparatus. It has never been contemplated in previous schemes for the school, and could only now be taught by the suppression of something already prescribed. We cannot tell in what proportions the income would be divisible under the last three heads, as every pupil goes through the same course of Classics, Mathematics, and English, all of which are taught, and a fee paid which includes these subjects. This annual fee is 3*l.*, paid half-yearly. WILL. C. SPARROW, LL.D., Head Master.
—	—	—	I have only recently been appointed Head Master of Newport Grammar School. It is a school of large endowment, some 1,500*l.* a year. At present there are about 90 scholars. No Science was taught when I went there in January last. At present the first class, 14 boys, do Natural Philosophy. Next half year I hope to have 30 doing it. There is no laboratory, and all the teaching has to be done solely by book. J. COLLINS, Head Master.
—	—	—	There is no instruction in Natural Science at this school, and only one Exhibition (lately established), for Classics and Mathematics. The boys are mostly young. AMBROSE SHORT, M.A., Head Master.
—	—	—	Natural Science not taught. There are two divisions of the school, Upper and Lower; in the first, Classics chiefly taught, but five boys learn Euclid. In the second, an English education only given, and that of a very meagre description, so that boys very seldom pass from the Lower to the Upper School. I am unable to state the net annual income; the gross is about 240*l.* The school shares in the Careswell Charity, and has two Exhibitions from that source to Christ Church, Oxford. Value, 60*l.* per annum each. WM. BOULTON, Head Master.
—	—	—	There is no instruction in Natural Science at present in the Whitchurch School; occasionally, in past years, instruction has been given in Botany. As all the Masters, except the French Master, take a part in the general teaching of the school, I cannot say how much is expended in teaching Classics, Mathematics, &c., separately. J. R. PEAKE, M.A., Head Master of the Whitchurch Grammar School.
190 0 0	80 0 0	80 0 0	It is impossible to answer the questions directly. Our staff consists of three graduates (Oxford and Cambridge), an A.R.A. for Drawing, and a Music Master. Chemistry is taught by the Second Master, who also teaches Mathematics, he being a Wrangler and First Class in Chemistry at Oxford Locals. Does the question "Hours of Instruction" allude only to Natural Science? If so, the answer should be three hours. A. D. GILL, M.A. (Head Master).
As the Masters, including myself, teach different branches of instruction, it is impossible to specify the amount expended on each subject. G. T. GOWRING, M.A., Head Master.			—

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
SOUTHAMPTON.				
Portsmouth.				
—	None.	—	—	—
STAFFORD.				
Rugeley.				
No Exhibitions. 225*l.* Head Master; 70*l.*+50*l.* Second Master from Head Master.	12	4	—	No.
Walsall.				
Gross, about 1,100*l.*	None.	30 hours.	—	—
SUFFOLK.				
Bury St. Edmund's (Grammar School)				
About 590*l.*,* of which Exhibitions take 220*l.*	22	Half an hour.	Counts to a trifling extent along with Mathematics.	None.
Ipswich.				
109*l.*, which is absorbed in payment of rent of school buildings. Exhibitions, 147*l.*	15	2	Nil.	At present none, but there is a prospect of some additional buildings being erected.
Woodbridge.				
About 400*l.*	18	2	No Exhibitions yet.	No.
SURREY.				
Croydon.				
—	None.	—	—	—
Southwark (St. Saviour's Parochial School).				
—	—	—	—	—
SUSSEX.				
Hastings (Parker's).				
—	—	—	—	—
Horsham.				
—	—	—	None.	No.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
—	—	—	The school is at present in a transition state, pending its reconstruction. A. Russwurm, Head Master.
225	70	50	As yet Natural Science is represented by elementary works on Astronomy and Chemistry. For the last year, and for the succeeding one (perhaps certainly), 50*l.* out of the Head Master's salary has been, and will be, paid to a Third Master, who teaches Classics and Mathematics. (Rev.) Edward Rogers Pitman, M.A., 1846, Christ's Coll., Cambridge, Editor of "Iphigenia in Tauris," 1857.
660*l.* for both subjects.		—	Some years ago there was a Chemistry class; for a time it flourished, but as the subject was optional the numbers fell off, and the class was discontinued. The boys then paid 10*s.* each a year for tuition in Chemistry, and the Governors of the school allowed an additional salary to the teacher of 2*l.* Under the new scheme, it is proposed to make one of the Natural Sciences not *optional* but *compulsory*. Walsall, July 3, 1871. A. C. Irvine, Head Master.
275 0 0		Nil.	* From Report of Commissioners, p. 146. Half an hour per week is devoted to the fourth and fifth Forms by the Head Master in teaching the general principles of Natural Philosophy, and explaining the mechanical powers and ordinary instruments and machines. Different Masters take upper and lower work in different subjects, so that it is utterly impossible to classify the amount expended in different branches of teaching. There is no possibility of apportioning the sums paid by the endowment for Classics, Mathematics, and English separately. A. H. Wratislaw, M.A., Head Master.
The same Masters are employed in teaching both these subjects, so that there is no possibility of instituting a comparison under this head. The Head Mathematical Master teaches the little amount of Natural Science which is undertaken.		—	A scheme will be shortly submitted by the Trustees to the Charity Commissioners for appropriating a considerable sum to the uses of the school, and it is probable that some portion will be devoted, provided the application be successful, to the promotion of Natural Science teaching. The funds of the school at present are insufficient to provide adequate salaries for the existing Masters. H. Holden, LL.D., Head Master.
It is difficult to answer these questions, as we have no special Master for the teaching of Natural Science. William Tate, M.A., LL.D., Head Master.			
—	—	—	The Whitgift Middle-class School was opened on the 4th of May 1871, and at present Science is not taught in it. It is hoped that in the course of the next year instruction in some branches of Natural Science may be given. Robert Brodie, M.A., Oxon, Head Master. July 3rd, 1871.
—	—	—	The instruction given in this school is purely elementary, and *no time* is devoted to the study of the Sciences. Richd. Hunt.
—	—	—	Natural Science is not taught in the above school. John Banks, Master.
Nil.	Nil.	Nil.	The Head Mastership of this school is at present vacant. The Trustees of the school are the Mercers' Company of London. I do not know the net annual income. It was founded for 60 poor children, and the Trustees added 20 in 1857; the total 80 are chosen by the local Governors from the poor, and receive their education entirely free of any charge. There are no Exhibitions attached to the charity. The present scholars are of that class of life found in the upper classes of national schools. July 3rd, 1871. Rd. Cragg (Usher), Acting Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
WARWICK.				
Atherstone.				
About 220*l.* About 40*l.* a year privately subscribed for Exhibitions tenable at school.	13	About 6.	It balances Greek for older boys, and counts equally with it.	Maps at present. Formation of a small museum in progress.
Coventry (Bablake).				
Not known officially.	—	—	—	—
Stratford-on-Avon.				
310*l.*	—	31	None.	None.
Sutton Coldfield.				
About 330*l.* No Exhibitions.	31	From 2 to 4 hours per week.	There are no Exhibitions.	There are all the necessary apparatus and chemicals, &c., for experiments.
Warwick.				
Salaries for four Masters, 400*l.* Capitation fees, about 140*l.* Three Exhibitions, 195*l.*, 65*l.* each.	No instruction in Natural Science.	—	—	—
WESTMORELAND.				
Appleby.				
230*l.*	No Natural Science taught.	—	—	—
WILTS.				
Marlborough.				
Net annual income of school about 190*l.* No Exhibitions held in the school.	42	About three hours to Botany or Natural Science.	No Exhibitions.	None.
The Close, Salisbury.				
712*l.* net, including clothing and boarding of boys and premiums.	None at present.	—	—	—
WORCESTER.				
Dudley.				
Two Exhibitions of 30*l.* each.	—	A lecture of one hour's duration.	—	—

AMOUNT EXPENDED IN TEACHING.			REMARKS.
Classics.	Mathematics.	Natural Science.	
		£ s. d.	
* —	—	—	A fortnightly course of lectures, by lecturers invited by Head Master, delivered last autumn. * It is impossible to give even an approximate estimate, as at present the Head Master alone takes the Natural Science, and receives no special payment for it. The Trustees, as far as they have the power, expend a small sum on necessary apparatus at the suggestion of the Head Master. As the school had been at a low ebb before and at the appointment of the present Head Master, and is only just recovering its number, the teaching of Science is necessarily only in embryo, but it is intended to extend it by degrees as opportunity offers. (Signed) SMITH W. CHURCHILL, M.A., Head Master.
—	—	—	I have myself taught the elements of Geology and Physiology, but these subjects do not form part of the school routine. F. W. HUMBERSTONE, A.K.C., Head Master.
—	—	—	The only Masters provided by the Foundation are a Head and Second Master, who are responsible for the Classical, Mathematical, and English work of the school. The present Head Master has obtained also the assistance of French and English Masters. The Head Master is sensible of the value of Natural Science, and has made several efforts to introduce the study of it into the school. As, however, the only persons qualified to teach it are himself and the Second Master, and they cannot multiply themselves at pleasure, but little time can be devoted to the study. It requires considerable time and a competent staff to maintain Classics, Mathematics, and English in an efficient state. H. GRIFFITH EVANS, M.A., Head Master.
* —	—	40 0 0	*It is impossible to determine the amount spent separately on teaching Classics or Mathematics, because all the Masters teach both branches of education. ALBERT SMITH, M.A., Head Master.
—	—	—	—
—	—	—	C. THRELKELD, M.A., Head Master.
Cannot be stated under specific heads. Salaries of assistants about 350*l.* besides board and lodging.			For several years classes have been instructed and prizes given for advance in Natural Science, and the formation of botanical collections, &c., has been encouraged as much as possible. Owing, however, to the class from which the majority of the pupils come being unwilling to incur additional expense, and other reasons, we have not made much progress in our little museum. The great drawback under which we are now suffering is the utter uncertainty as to the future of the school. We can incur no expense while we are in ignorance of what the school is to be, classical or modern, first or second grade. F. H. BOND, M.A., Master.
—	—	—	It is probable that ere long an alteration in the teaching staff will be made, which will allow of the introduction of elementary Natural Science. EDMUND DOWLAND, M.A., Master. July 6th, 1871.
—	—	—	We have no laboratory. For one hour per week a lecture is given on Natural Science to two classes, consisting of about 24 boys between them. This takes place on each Thursday from 10.15 to 11.15 a.m. We attach equal weight to Natural Science as to Classics or Mathematics. We have two Exhibitions of 30*l.* per annum each for scholars going to Oxford or Cambridge; but only one has yet been held, so there has been no competition for them. ROBT. HARPER, M.A., Head Master.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
WORCESTER—*cont.*				
Hanley Castle				
247*l.*	About 15 last term.	3½	No Exhibitions.	None as yet.
Kidderminster.				
—	—	—	—	—
Stourbridge.				
One of 50*l.*; one of 8*l.*	15	3 hours.	None.	Suitable chemicals and apparatus are provided.
Worcester (Royal Free Grammar School).				
—	From 20 to 30.	About 1.	—	Small Geological museum.
Worcester (Worcester Cathedral School).				
There is no separate endowment. Three of the Masters are paid by the Dean and Chapter: 200*l.*, 150*l.*, and 100*l.* respectively.	All the classes above the lowest learn Natural Science; about 80 boys on an average.	One hour a week to each class.	—	No laboratory. Text books and diagrams.
There are 40 King's Scholars, who receive a free education for four years, and 2*l.* 13*s.* 4*d.* each yearly. There is no extra charge for teaching, except an optional one of 2*l.* for Modern Languages and Drawing.				
Wolverley (Kidderminster).				
—	4	—	—	—
YORK.				
Bingley.				
Income, including Woolers, 450*l.* (net).	*7	—	No Exhibitions.	None.
Giggleswick.				
About 1,100*l.* [See Appendix, p. 244.]		—	—	No.
Halifax.				
—	—	—	—	—
Hemsworth.				
700*l.* No Exhibitions.		—	No Exhibitions.	None.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
£ s. d.	£ s. d.	£ s. d.	
Cost of tuition from endowment for all branches, 170*l.*			This school was in a deplorable state at the visit of the Inspector on behalf of the Royal Commission. Consequently the Head Master was removed, a new scheme obtained, and there are now 60 pupils, besides the Elementary Department. On account of building large schools, funds have until now been wanting. In the future any surplus will be appropriated for providing laboratory, &c., at least as soon as the school is in a state to warrant the outlay. Our new scheme provides for instruction in elementary branches of Science. W. Walker (M.A., &c.), Head Master.
—	—	—	Till the present year, no instruction has been given in this school in Natural Science. This present year we have begun short weekly lectures in Chemistry, but without laboratory or other aids. The School is in a state of transition, there being no Head Master, and a fresh scheme being made. Lionel B. Penley, Master *pro tem.* P.S.—I am not able to fill up the form. I am at present the sole Master, and there are under 20 boys.
—	—	—	I cannot fill up the last column, because the teaching of the Masters is not confined exclusively to one branch. W. J. J. Welch, M.A., Head Master.
Cannot be separated. No special payment at present for teaching Science.			Two courses of Geology in the year, each lasting a month or five weeks, and including four night lessons per week and corresponding lectures in school. From four to six excursions each year to teach Geology in the field, accompanied by field lectures given by the Master or other competent persons. The Head Master is anxious to obtain assistance in teaching other branches of Natural Science but has not as yet been able to procure competent teaching for the small sum at his disposal.
The amount expended in teaching these subjects cannot be exactly given, as most of the Masters take classes in each of them.			Maurice Day, M.A., Head Master.
—	—	—	I am the only Master. W. Shutt.
†—	—	—	* No Science Master, or special hours devoted to same; taught in Class Book of Modern Science twice a week by Head Master. † Income not distributed over separate subjects. (Signed) Thomas Dixon, B.D., Head Master. July 19th, 1871.
—	—	—	It is impossible to send any useful information with reference to this school. A scheme of work recently adopted by the Board of Governors directs that instruction in Science should be given. But we are waiting for the action of the Endowed Schools' Commission, who have been engaged for some time on a new scheme for the school. Every one will gladly help forward Science teaching when the new scheme comes. G. Style, Head Master. July 1871.
—	—	—	There is no provision for any scientific teaching at this school, there being no funds either from endowment or from fees available for the payment of a Master. The Head Master, too, has no time, as he has to teach to the upper boys Latin, Greek, Divinity, English Literature, and Mathematics; and, to do these well, a division of labour would be a good thing. July 4, 1871. Thomas Cox, Master.
90 0 0	90 0 0	—	Clause 29 of the *Scheme* provides that "the principles of Chemistry and Physical Science generally" should be taught if in the judgment of the Trustees they be necessary to render the "foundation of the most general use and benefit."

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
YORK—*cont.*				
Kirkby Ravensworth, near Richmond. 245*l.* 16*s.* 8*d.*	10	From March 1 to November 1, 32½ hours. From November 1 to February 28, 30 hours.	There are no Exhibitions.	None.
Kirkleatham. —	—	—	—	—
Leeds. Income, 1,421*l.* Exhibitions, 50*l.*	Systematically studying Science, average 8. Incidentally, average 60.	12	None.	A laboratory with all necessary appliances.
Mirfield. 208*l.*	21	1	No Exhibitions attached to this school.	None.
Pocklington. Income somewhat in excess of 1,000*l.* Exhibitions, 160*l.*	6	26, besides 8 of evening preparation.	The examination is conducted at St. John's College, Cambridge, in Classics and Mathematics generally. Very considerable weight would be assigned to proficiency in the latter, including Natural Science.	None.
Ripon. Net income, about 700*l.* No Exhibitions.	About an average of 12.	*—	—	Yes.
Rishworth. 3,300*l.* Exhibitions, 150*l.*	—	36	—	—

AMOUNT EXPENDED IN TEACHING.			REMARKS.
Classics.	Mathematics.	Natural Science.	
*—	†—	£ s. d. ‡—	As a general rule parents and guardians or friends do not allow pupils to remain at this school a sufficient length of time to enable such pupils to extend their education to the Natural Sciences further than to the bare elements, which I introduced in teaching the nature of, and the laws governing common things. I cannot so divide the Masters' stipends as to fill up columns marked by me (*), (†), and (‡). (Signed) JOSHUA WOOD, Clerk, M.A., Head Master, &c.
—	—	—	Sir William Turner, Knight, Alderman, and Lord Mayor of the city of London, Founder of the Alms' House at Kirkleatham in Cleveland, in the County of York, for the habitation of 10 old men, 10 old women, 10 boys, and 10 girls. That the Master shall daily provide dinners for the 10 brethren, and shall attend to their general comfort, especially in times of sickness. The Matron the same on the women. The Master to provide for the boys good, wholesome, and sufficient food, find them in washing, and see that their beds, lodging, and clothing be well and decently ordered and kept. The Matron the same. The boys to be instructed in Reading, Writing, and Arithmetic, English Grammar, Geography, and History. The girls the same. J. H. CARR, Master.
Assistant Masters, 950*l*.		85 10 0	The boys studying "systematically," who are the only real students of the subject, give at least three mornings and three evenings entirely to the study. Those who take it as an incidental or subordinate part of their work, give only two hours a week. I would observe that there has been every anxiety on the part of the Trustees and the Master to encourage scientific studies in the school; that liberal prizes have been founded for their encouragement; that the present Scientific Master is, as was his predecessor, a gentleman of great ability; yet that these studies are not popular with parents, and that the scheme, so far as a special department for such study, can hardly be considered otherwise than unsuccessful; as its success should be measured by the number of pupils who study Science systematically. Even in the case of boys where these subjects form a compulsory part of their work, objections have often been raised by parents. It is, in fact, the only branch of the ordinary course towards which disinclination is shown. No weight is assigned to Natural Science in examinations for Exhibitions, as the subjects of examination stand at present under the school statutes, bearing date June 7, 1855; but a new scheme for the school, including this matter of the Exhibitions, is at present under the consideration of the Endowed Schools' Commissioners. The sum given or paid to Assistant Masters unavoidably includes that for French and for English subjects. The amount at present paid for Scientific teaching is sufficient to meet the demand. If there were more boys willing to follow the course, there would not be the least hesitation in providing additional instruction. W. G. HENDERSON, D.C.L., Master.
—	—	—	The total amount paid to the Head Master for all subjects is 120*l*. Out of school fees he has to provide all assistance. A new scheme is pending, which may give greater weight to Natural Science. (Signed) GEO. GREEN, Head Master. July 3rd, 1871.
The same Masters teach all these branches. The Master and Usher of the school are entitled to the income from the estates. No additional charge is made for any teaching in any of these branches of learning.			Returns of the income and expenditure are made annually to the Charity Commissioners. The course of instruction in Mathematics, &c. embraces, Arithmetic, Euclid, Algebra, Trigonometry, Mechanics, Hydrostatics, Optics, Chemistry, Differential and Integral Calculus, Conic Sections, both Geometrical and Analytical, &c. &c. N.B.—The Head Master is at this moment away from his books, papers, &c.
No separate sums are assigned to these subjects. The Head Master and Usher (whose united income is 370*l*. per annum) teach Classics and Mathematics each to his own classes, and so much of Natural Science as is stated below.			* No stated time per week can be put down as given to Natural Science. So soon as the two senior classes have mastered the elements of Euclid and Algebra, they are taught the Mechanical Powers, the Law of Gravitation, Modes of determining the Specific Gravity of Solids, the Use of the Barometer, &c., and are set to work examples in these subjects. *About* 10 *days or a fortnight* in *each half year* are given to this study as a general rule. July 6, 1871. J. F. MACMICHAEL, Head Master.
Head Master - - - 200 0 0 Second ditto - - 100 0 0 Preparatory ditto - - 80 0 0 Usher - - - 20 0 0 Mistress - - - 50 0 0 £450 0 0 Drawing - - - 40 0 0 Singing - - - 15 0 0 Drilling - - - 15 0 0 French - - - 30 0 0 £550 0 0			There is no provision for teaching the Natural Sciences.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laborary or other Aids for Practical Teaching in Science.
YORK—*cont.*				
Sedbergh.				
—	—	—	—	—
Wakefield.				
About 350*l*. Exhibitions, 350*l*.	None specially.	25	"Brewer's Guide to Science" is learnt, and questions set from it.	There is an apparatus, but no funds to find teachers.
York (Archbishop Holgate's School).				
The endowment a little more than 400*l*. per annum. We have no Exhibitions.	About 20 boys learn Agricultural Chemistry.	—	—	No.
Clifton (St. Peter's).				
The *exact* amount is stated in Appendix to 1st Volume of Schools Commissioners' Reports. About 900*l*. There are *no Exhibitions* in the strict sense of the word. (*a*.)	80 (the *VI.*, *V.*, and *IV. Forms*, and the boys in the Modern Department).	The VI., V., and IV. have *one lesson* a week of three quarters of an hour *each*, with work to prepare between lessons. The boys in the Modern Department have *two* lessons a *week*. Do. (*b*.)	At present none but prizes are awarded.	The Master who teaches Zoology, &c., illustrates by specimens, and the Chemical Lecturer has abundance of materials for experiments supplied by himself.

Amount expended in Teaching.			Remarks.
Classics.	Mathematics.	Natural Science.	
—	—	—	There is no teaching in Natural Science at present, that not being a subject required by our charter. Henry George Day, Head Master.
120*l.*, Head Master, with house. 100*l.*, Second Master, without house, for Classics, Mathematics, and English generally.			I append the school programme, as settled by a new statute 14 years ago:— "The Rev. J. Taylor, D.D., begs to inform his friends and the public "that by a recent statute the school routine embraces Religious Instruction in the principles of the Church of England, Old Testament and "Gospel History, the Latin, Greek, and French Languages, Mathematics, "Algebra, and Arithmetic, Writing, Drawing, Geography, with the use "of the Globes, Ancient and Modern History, and English Literature. "While Classics and Mathematics are pushed as far as possible with "pupils destined for the Universities, all the subjects of a thoroughly "good English and Commercial education are carefully attended to. "Sound Religious Instruction is also given, based on the principles of "the Church of England." J. Taylor, D.D., Head Master.
—	—	—	Sir, Parrox Hall, near Fleetwood, July 11, 187–. Your communication of the 30th ult. has reached me here, and I have given you what information I can on the subject of it. It is impossible to say what sum is expended in teaching Classics and Mathematics, &c., separately, as the Masters are paid for teaching all the subjects of a general education. I may add we give more attention to Mathematics and a general English Education, including Political Economy, than to Classics. A majority of the boys also learn French. I am, &c., R. Daniel, Head Master.
— (*c.*)	— (*c.*)	— (*c.*)	(*a.*) *One* Exhibition to the Universities for three years of 50*l.* is annually awarded by the Dean and Chapter (the Trustees of the School), after examination in Divinity, Classics, and Mathematics. There are *eight* Foundation Scholarships (entitling to *free board* and *education*), tenable for four years, and *eight* Free Scholarships (entitling to free education), tenable for four years, open for competition to boys who have been in the school for one year, and are under 15 years of age. The subjects of examination are Divinity, Classics, and Mathematics. (*b.*) The boys in these forms have been during the past year specially studying *Zoology*. There is also a Voluntary Class, taught by Dr. Procter, an eminent physicist in York, who teaches *Chemistry*, *Electricity*, *Heat*, *Light*, &c., taking these subjects in turn. He attends for one hour a week, and a charge of 1*l.* 11*s.* 6*d*, for each half year is made. He teaches by lectures and experiments, and gives two prizes at the examination. The papers in *Zoology* (for which *four prizes* were awarded at our recent examination, and for which the boys were ranked as in Classics and Mathematics, French, &c., separately), and in Chemistry (for which two prizes were awarded), are contained in the examination book, of which I send a copy.

(*c.*) I do not know how to make a clear statement on this point in a few words. There are *nine* regular Masters attending the school daily, and one (teacher of French and German) who attends four days in the week; of these the following teach *Classics*, *History*, *Geography*, &c.

Head Master, with salary, of	250	a year.	House for boarders	} Paid by Trustees.
Second do.	300	„	No house.	
Third do.	200	„	Do.	
Fourth do.	160	„	Do.	
Fifth do.	120	„	Do.	
	£1,030			
Sixth do.	110 (paid by Head Master).			

Of the three remaining Masters:—

1. Is *Head Mathematical and Natural Science Master*, receiving a salary of 250*l.* a year (taking the VI., V., and Upper IV. in Mathematics, and the VI., V., IV., and boys of Modern Department in Natural Science, Zoology, &c.). He rents a house for boarders. He teaches Mathematics and Natural Science exclusively.
2. Is Head of the Modern Department, teaching Mathematics, History, Geography, Book-keeping, Navigation, and Natural Philosophy (when boys specially need it for some examination), and receiving a salary of 220*l.* a year.
3. Is Lower Mathematical Master, taking the Forms below the Upper Fourth in Mathematics exclusively, and receiving a salary of 100*l.* a year, renting a house for boarders.

The fees for *all* these Masters, as also for French and German, are included in *the ordinary school fees* of 13 guineas for the Upper School, 11 guineas for the Lower School.

I have tried to explain the present system of teaching Natural Science which I have introduced into our school as a *beginning*, and while waiting for the new scheme to be drawn up by the Endowed Schools' Commissioners, and I hope that my remarks may be intelligible, with the aid supplied by the examination book, which I send. As our Natural Science Master is also a Mathematical Master, I did not know how to fill up the columns relating to the amount expended in teaching, and thought it better to enter into details, as I have done in *note* (*c*), and I must apologise for any shortcomings or want of clearness in my statements.

I may, perhaps, be allowed to add that one of the former members of St. Peter's School, A. W. Reinold, Esq., late Fellow of Merton College, Oxford, is now Lee's Reader in Physics at Christ Church College, Oxford; that another, the Rev. Richard Albay, now Fellow of Wadham College, Oxford, was formerly Lecturer and Demonstrator in Experimental Philosophy at King's College, London, and has been succeeded by another of the members of our school, H. Tomlinson, Esq., who also gained a Whitworth Exhibition in the University of Oxford.

R. Elwyn, Head Master of St. Peter's School.

Net Annual Value of Income and Exhibitions.	Number of Scholars learning Natural Science.	Hours of Instruction per Week given by Masters.	What Weight assigned to Natural Science in Examination for Exhibitions.	Whether any Laboratory or other Aids for Practical Teaching in Science.
YORK—*cont.*				
Giggleswick.				
1,000*l.*	70	Chemistry, 3 or 4 hours; Physics, 3 hours.	There are no exhibitions which are competed for by boys already at the school.	An excellent chemical laboratory. A fair amount of apparatus for teaching physics.

ANALYSIS of the foregoing RETURNS from SCHOOLS having ANNUAL ENDOWMENTS amounting to 200*l.* and upwards.

Number sent to.	Number of Returns.	Number in which Science is taught.	Number having a Laboratory.	Number having limited Apparatus for Teaching Science.
205	128	63	13	18

APPENDIX.

AMOUNT EXPENDED IN TEACHING.			REMARKS.
Classics.	Mathematics.	Natural Science.	
—	—	—	According to the Scheme of the Endowed Schools' Commissioners, at least two branches of Natural Science must be taught in the School. Chemistry and the various branches of Physics are taught to all boys in the Upper School; and all (except those in the lowest class) receive instruction in Practical Chemistry and Analysis. The laboratory is well provided with apparatus and chemicals for the practical study of Chemical Science. To the erection of the laboratory and the provision of apparatus, the Governors have recently appropriated over 1,200*l.*; and the building is shortly to be extended. Natural Science has the same weight in determining promotion in the school and prizes as the other main branches of instruction. The Senior Assistant Master devotes nearly the whole of his time to Chemistry and Physics. The School depends upon these subjects and Mathematics for distinction at the Universities and elsewhere. A museum is in process of organization, which will contain various typical collections.

GEORGE STYLE, Head Master.

31st March 1874.

B.

[The following letter and form were sent, on the 16th of November 1874, to the Head Masters of the one hundred and twenty-eight Endowed Schools contained in the preceding list.]

Royal Commission on Scientific Instruction and the Advancement of Science,
6, Old Palace Yard, S.W., 16th November 1874.

Sir,

I am directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to facilitate the labours of the Commission by filling in the form at the foot.

You would confer an additional favour if you would place His Grace in possession of this information at the earliest possible moment.

I have the honour to be, &c.
J. Norman Lockyer, Secretary.

Endowed School at ____________________

1. Number of boys in the School - - - - __________
2. Number of boys learning Science - - - - __________
3. Number of hours given per week by each boy learning Science to that subject in class time. (If some boys give more than others this should be stated.) - - __________
4. Number of hours given per week by each boy learning Science to laboratory or practical work - - - __________

[The following returns have been received.]

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	Remarks.
ANGLESEY.				
Beaumaris.				
14	—	—	—	Those parents who *wish* their boys to learn Science can have them taught. There is no extra charge, and one of the masters is competent to teach Chemistry, &c. C. P. Milner, B.A., Camb., Head Master.
BEDFORD.				
Bedford.				
A little more than 270	A few occasionally, voluntarily, from a teacher, *unconnected with the school*, on the South Kensington plan.	—	—	By the New Scheme for the government of the school, Natural Science is required to be taught; but the Governors have not yet made the arrangements necessary for its being done. F. Fanshawe, Head Master. Nov. 17, 1874.
BERKS.				
Abingdon.				
70	Nearly all at times have some instruction.	Various—at times two hours.	No practical work, as there is no laboratory.	—
BRECKNOCK.				
Brecon (Christ's College).				
46	—	—	—	J. D. Williams, Head Master. Nov. 23, 1874.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
CAMBRIDGE.				
Cambridge.				
147 (nearly half forming a Junior, *i.e.*, practically a Second Grade School).	Botany, 8 } 13 Chemistry, 7 (2 boys do both subjects).	Four hours; two to each subject.	Two boys give six hours per week.	Science is made a voluntary subject. Any boy, on coming into the Vth Form, may choose between Classics, Mathematics, and Science. If any boy makes choice of any of the three, he is allowed to devote most of his time to it—reading only as much of the others as is necessary for the previous examination. As Science has only been introduced within the last year, it has not won its place compared with the other two.
CHESHIRE.				
Chester (Cathedral Grammar School).				
—	—	—	- -	I give a lecture on Botany in the School *occasionally*, but we have no fixed days or hours for this. JAMES HARRIS, Head Master.
Macclesfield (the Modern School).				
132	68	All the 68 boys give 2¾ hours per week, and in addition to that 38 of them give 1½ hour to Laboratory Practice.		—
Sandbach.				
57	20	Two hours	One hour	W. D. MADDOCK, M.A., Head Master of Sandbach School, and late Fellow of St. John's College, Oxford.
DERBY.				
Repton.				
240	Science School in process of organisation; *all boys* to learn after Christmas.	Time not yet determined, probably *two* hours a week for ordinary classes.	—	HENRY R. HACKIN, Head Master.
Risley.				
19	None.	—	—	S. GOLDNEY, M.A., Head Master.
DEVON.				
Exeter (Hele's).				
200	Physical Geography, 95.	One hour and a half.	—	CHARLES LONG, A.C.P., Head Master.
DORSET.				
Sherborne.				
247	111	56 give 1½, 55 one hour per week.	12 give 5 hours per week, in addition to lecture-time given under "3."	The Science School is not considered to be in proper working order yet. H. D. HARPER.
DURHAM.				
Darlington.				
43	Natural Philosophy, Physical Geology, Mathematics, 10.	4	—	This school will be closed at Christmas by order of the Governors, pending arrangements for carrying out a new scheme, sanctioned by the late Commissioners. JNO. MARSHALL, B.A., Head Master.
ESSEX.				
Chigwell.				
148	123	Two hours; three boys give *ten* hours. Chemistry and Physics taught.	Two	Our great difficulty is want of funds to furnish a Laboratory, and a supply of trained Teachers. H. M. ROBINSON, Head Master.
Dedham.				
96	26	Some two, others five or six.	Variable and uncertain.	G. T. LERMIT, L.L.D., Head Master.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
ESSEX—*cont.*				
Earl's Colne.				
45	16	Four hours.	—	—
Newport.				
13	None - -	None - -	None - - -	SAMUEL PEACOCK, Usher and Master in charge. Nov. 21st 1874.
GLOUCESTER.				
Bristol (Grammar School).				
294	64	Two hours - -	This work is not done by all the boys who learn Science. Those who do the work give about three hours per week to it (in other than class hours) in addition to the two hours given to Science, as by Question 3.	The Grammar School at Bristol is the First Grade Public School of the district. Its work is adapted to the needs of boys who are preparing for the Universities, for the Public Service, Civil or Military, and for the Professions. There are divisions of classes for other boys who desire an education better suited to business or commerce. Under the present scheme it has been found impossible to make Natural Science a part of the ordinary school work, and the teaching of the subject has been an "extra" which those boys have been allowed to take up who have preferred it to verse composition in Latin and Greek. The practical work is done in hours when the other boys are not in school. A Scheme of the late Endowed Schools' Commission (which is understood to be unopposed, having been accepted by the Governing Body of the School and the masters) is at present before the Privy Council, by which scheme Natural Science is made one of the subjects of instruction in the ordinary course of school work. Certain portions of the subject will then be taught to all boys in the school; a more extended course being allowed as an alternative for Greek and Latin verse composition. JOHN W. CALDICOTT, D.D., Nov. 17, 1874. Head Master.
Cheltenham.				
120	42	Div.— I. (2) { Chemistry 3 Physics 3 II. (7) Chemistry 2 III. (20) Chemistry 2½ IV. (13) Chemistry 2	Divisions I. and II. one hour, subtracted from the preceding hours.	HENRY M. JEFFERY, M.A., Head Master of Pate's Grammar School.
Gloucester (the King's or Cathedral School).				
70	Six - - -	Two - - -	One - - -	W. BEDELL STANFORD, Head Master.
Northleach.				
35	20	Two - - -	—	—
HEREFORD.				
Hereford (attached to the Cathedral).				
108	No regular science teaching in the school.			ERIC J. S. RUDD, M.A., Head Master.
Kington.				
None.	None - -	None - - -	None - - -	The school is temporally closed for extensive repairs, almost rebuilding; J. N. Walsh, M.A., late Master.
HERTS.				
Berkhampstead.				
113	Between 40 and 50.	One hour (preparation not reckoned).	—	We have no Laboratory, thanks to the Endowed Schools' Commission, without which we could not and cannot move; our plans for one were prepared, and would have been carried out some years ago, had we not been under "Commission." E. BARTRUM, Head Master.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
KENT.				
Canterbury.				
110	10	Two - - -	One.	—
Canterbury (Clergy Orphan School).				
105	None - -	—	No Laboratory; no funds for its erection, or special teaching.	(Signed) C. MATHESON, Head Master.
Lewisham.				
71	65	Half an hour, entirely elementary.	No accommodation.	THOMAS BRAMLEY, M.A., Head Master.
Rochester.				
90	None - -	They leave the school at 15 years of age.	—	—
Tonbridge.				
230	None - -	None - - -	None - - -	We have more than once tried to get up Science Classes, but our efforts have failed, because (1) the boys were allowed by their parents to leave off learning when they pleased; (2) because we have no power to compel boys to learn. We are waiting for a new scheme. J. I. WELLDON, D.C.L., Head Master.
LANCASTER.				
Blackrod Grammar School.				
—	—	—	—	Highfields, Blackroad, Chorley, Lancashire, SIR, Dec. 8th, 1874. IN answer to your request, dated 16th November 1874, on behalf of the Royal Commission on Scientific Instruction, I write to inform you that this school, being at present in a state of transition, awaiting the decision of the Educational Commissioners relative to a proposed scheme for its amalgamation with that of a neighbouring township, I have not been able to form a Science Class, as my numbers are too small to allow of my doing so. I have, &c., H. FRANK MALTBY, Head Master.
Bolton-le-Moors (Grammar School).				
58	Practical Science is not taught.	—	—	—
Burnley.				
70	30	2	1	—
Clitheroe.				
The two schools (Upper and Lower) have 62 boys.	Chemistry, Electricity, and Magnetism, 19 boys.* Mathematics and Theoretical, Mechanics 19 boys.*	Chemistry, &c., 2 hours. Mathematics, 6 hours. Mechanics, 1½ hours. This is exclusive of *preparation*, which is done out of class time, and practically adds several hours more.	None yet sufficiently advanced.	EDW. BODEN, M.A. (Cantab), 17th Nov. 1874. Head Master.
Great Crosby.				
84	27 learn Euclid, Algebra, and Trigonometry; 1 boy learns Mechanics.	5 hours of class teaching, besides private work.	—	—

---

* The identity of number in these classes is accidental, the classes comprising only partially the same members.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
LANCASTER—*cont.*				
Manchester.				
595	See table below.	See table below.	See table below.	DEAR SIR, Nov. 16th 1874. I HAVE filled up the enclosed form. The Science work of the School will be best seen by a reference to the middle pages of our honour list, where the results of the Government Science and Art Examinations are given. I have forgotten whether in previous returns I mentioned that Miss Brackenbury founded two or three years ago two Exhibitions for Science to the University of Oxford. In the commencement of the present year Mr. Langworthy founded 20 Scholarships, with 20*l.* each, tenable each for a year at the School; at least a fourth of these will be given for Science. I am, &c., FRED. W. WALKER. Norman Lockyer, Esqre.

			Physics.	Chemistry.	Total.	
75	boys	Upper and Middle French, I.	1	0	1	hour per week.
74	„	Upper and Lower French, II.	2	0	2	„
37	„	French III., -	0	3	3	„
32	„	Modern Language, IV.	0	3	3	„
21	„	Do., V. -	0	1½	1½	„
25	„	Science V., -	5¼	3¼	8½	„
21	„	Science transitus -	4¾	8	12¾	„
18	„	Science, VI. -	5½	8	13½	„
9	„	Mathematical, VI.	1½	1½	3	„
312						

PRACTICAL WORK.

18 boys give 3 hours per week to } Practical Physics.
30 „ „ 1½ „ }

40 boys give 5½ hours per week to }
19 „ „ 2¼ „ } Practical Chemistry.
69 „ „ 1½ „ }
28 „ „ 1 „ }

This return does not include the following optional classes:—

Magnetism and Electricity,	attended by 16	boys.
Chemistry	„ 38	„
Animal Physiology	„ 51	„
Steam	„ 21	„
Applied Mechanics	„ 30	„

Neither does it include Mechanics or Physical Geography, which are taught through a large part of the school.

FRED. W. WALKER,
High Master, Manchester Grammar School.
Nov. 18, 1874.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
Wigan.				
160	40	Three - - -	One and a half. At present only nine boys. This part of the study has been till lately quite neglected, owing to want of proper accommodation. The Head Master, feeling the importance of the study in this district, has lately furnished apparatus for the purpose of promoting the study, and in anticipation of new and more commodious buildings.	—
LEICESTER.				
Ashby-de-la-Zouch.				
In the "Latin School," *i.e.*, the upper part of the Grammar School, there are 40 boys; none learning Science. In the "English School" there are 140 boys, 20 of whom are learning Science.	20	2 hours each to— Mathematics Chemistry Magnetism, and Electricity.	—	*Note.*—At the Examinations by the Science and Art Department in May last (1874), the following successes were gained by boys then in the English School:— I. In *Magnetism and Electricity* four passed in the *Advanced* stage, and 12 in the Elementary stage, six being First Class. (No failures.) II. In *Chemistry*, nine passed in the *First* Class, and four in the Second. (Three failures.) 11 passed in Laboratory practice, nine of them being in the First Class. III. In Botany, two passed. (No failure.)
Loughborough.				
125	—	—	—	We are passing through the Endowed School Commission, and shall probably have a new scheme next year, when Science will be introduced. It would have been introduced long ago but for want of £ *s. d.* A. BOWER, Head Master.
LINCOLN.				
Caistor.				
65	Science not taught	—	—	

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
LINCOLN—*cont.*				
Donington. 48	10	Three - - -	None, except that they are called upon in class to manipulate the models of simple machines.	W. J. R. CONSTABLE, LL.D., Head Master.
Heighington. 57	None	—	—	FREDERICK DAY, Head Master.
Humberstone. Limited to 100 generally kept on the list. Of course some are always absent out of the 100.	None, the boys leave when *fourteen*.	—	—	The average number of boys attending school varies, between 70 and 80. I shall be glad to answer any questions as correctly as I possibly can. CHARLES WILDBORE, Humberstone, Head Master. 20th Nov. 1874.
Stamford. 43	8	1	0	—
MIDDLESEX.				
Milk Street, Cheapside (City of London School). 677	All - - -	From 45 minutes to 75 minutes. 27 boys in the Practical Chemistry Class devote two hours a week on Wednesday afternoons; likewise, two or three boys preparing for the Examinations in Natural Science, receive extra instruction in the Laboratory.	None for the ordinary scholars, but those who take an extra interest in the subject attend the Practical Class and the after-lecture experiments.	—
St. Lawrence Jewry (Mrs. Elizabeth Smith's). —	—	—	—	No School in connection with this Foundation, but the boys are elected to Exhibitions for the City School and King's College, and will, it is presumed, be included in the returns obtained from those schools. JAS. HY. DAVIDSON, pp. Trustees, Vestry Clerk of St. Lawrence Jewry, 70, Basinghall Street, E.C. 24th Nov. 1874.
Edmonton (Latymer's). 202	57	1	No Laboratory.	—
Enfield. —	—	—	—	The school buildings having fallen into a very bad state, the school was closed. A new scheme obtained Royal assent July 1874, and the Governors are now about restoration, and when re-opened the standard will be raised. CHAS. CHAMBERS.
Hammersmith. 150 (N.B.—The average age of the three highest classes is 16, 15, 14.	29 (Chemistry and Elementary Geology.) (48 others Elementary Physical Geography.)	1½ hours (Also three boys learn Natural Philosophy for London University Matriculation, two hours additional.	None. (The Chemistry lessons are always illustrated by experiments.)	H. ST. JOHN READE, M.A., Nov. 16, 1874. Head Master.
Highgate. 172	About 110 -	33 boys 2½ hours, the rest 1 hour.	1½ hours - -	The subject has been only introduced within the last six months, and the time given to it will be increased next year.
Westminster (St. Peter's College). 205	93	56 give two hours, 37 one hour.	None; no facilities.	CHAS. B. SCOTT, Head Master.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	Remarks.
MIDDLESEX—*cont.*				
Whitechapel (Leman St.).				
211	130 (Upper School).	Lower classes two hours, Upper classes three hours.	Time divided between theoretical and practical work.	—
NORFOLK.				
Thetford.				
—	—	—	—	This school is closed at present, a new scheme being under consideration. A. Fowler Smith, M.A., Head Master.
Yarmouth.				
154	None - -	None - - -	None - - -	17 Nov., 1874. J. J. Raven, D.D., Head Master.
NORTHUMBERLAND.				
Haydon Bridge.				
89 (not including infants).	5	½ (on an average)	—	W. L. Pendered, Head Master.
NOTTINGHAM.				
East Retford.				
45	14	1½ hours - -	None at present -	Alfred Church, Head Master.
OXFORD.				
Magdalen College, Oxford (Disendowed).				
115	About 12 - -	From 9 to 15 or more.	About six - -	No boy learns Science here who is not trying either for the Indian Civil Service, Cooper's Hill, Woolwich, or a College Scholarship. (Signed) R. H. Hill, D.C.L., Head Master.
SALOP.				
Ludlow.				
71	40 (Mathematical Science exclusively.)	About 25 boys give six hours per week in class time. About 15 give four hours.	There is no Laboratory work, as none of the science is experimental.	By Mathematical Science are intended Euclid, Algebra, Trigonometry, Mechanics, Mensuration, Practical Geometry, Use of Scales, and Plotting from Field-books, Practical Solid Geometry. A proposal has been made to commence a course of Chemistry for young farmers, but at present the authorities do not see their way. Will. C. Sparrow, LL.D., Head Master.
Oswestry.				
82	—	—	—	It is the intention of the Head Master to begin teaching Elementary Science in January. M. S. Forster, Head Master.
Wem.				
Average attendance for the year, 15.	None - -	—	—	Wm. Boulton, Head Master.
Whitechurch.				
41	None - -	None - - -	—	There were Chemistry Classes in the school within the last two years, but the boys are now almost all young, and the teaching they require is quite elementary.
SOMERSET.				
Ilminster.				
26	11 for public examination, but the whole taught.	Four half hours, two to each subject.	None; subjects not requiring it.	W. J. Woodward, B.A., Head Master.
SOUTHAMPTON.				
Portsmouth.				
—	—	—	—	School closed.

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
SUFFOLK. **Bury St. Edmund's.**				
59	20	Half an hour per week, *i.e.*, one hour each fortnight.	None - - -	A. H. Wratislaw, Head Master.
Ipswich.				
90	75 attend lectures on Zoology, Geology, Physical Geography.	Two hours per week.	None,	Hubert A. Holden, LL.D., Head Master.
Woodbridge.				
—	—			The School House, Woodbridg Nov. 18, 1874. Sir, I lose no time in replying to your circular. To fill up the form sent to me would, I fear, be of no service whatever to the Commission. The school has been entirely reorganised within two months, and is now and will be for some time to come in a state of transition. Up to the time of my appointment no attempt had been made, I believe, to give any kind of Scientific Instruction. I have made some arrangements for that purpose, *i.e.*, I have masters who teach different Scientific subjects, and hours fixed for instruction in those subjects. But *at present* very few boys seem disposed to avail themselves of the opportunities offered. This defect will I hope gradually be remedied. We have, besides, no apparatus whatever. I have no doubt that the Trustees will make some provision in response to an application which I shall make to them in a few days. It would be, therefore, hardly fair, or serve any purpose, to fill up the return. The great difficulty we have to contend with is the present general indifference of parents to anything beyond the most elementary instruction. The supply is or will be shortly ready, but there exists at present no demand. I am, &c., Jas. R. Wood, Head Master.
SURREY. **Croydon.**				
288	145 are learning Physical Geography, Elementary Geology, or Physics.	From half an hour to two hours.	—	—
SUSSEX. **Horsham.**				
80	None - -	—	—	The boys in this school are of the class usually found in elementary schools, no charge being made. The Head Mastership is at present vacant. Rd. Gragg, Usher.
WARWICK. **Atherstone.**				
70	34	5½	—	The class-room in which Science is taught not being quite suited for Laboratory work, the necessary experiments are performed before the class, one of the pupils being allowed to perform them occasionally.
Coventry (Bablake).				
70	25	None. The instruction is given out of school hours.	None.	—
WESTMORELAND. **Appleby.**				
50	None regularly	None in class time	None as part of regular school work.	C. Threlkeld, Head Master.
WILTS. **Marlborough.**				
63	Two, preparing for "Local" Examinations.	We have no Laboratory, and so, *as part of the school course*, attempt nothing in Science beyond a little Botany occasionally.		F. H. Bond, M.A., Master.
The Close, Salisbury. Being a school for the *choristers* of Salisbury Cathedral, a Cathedral of the old foundation.				
14 choristers, and 7 day boys.	—			(Signed) Francis Lear, Canon Residentiary, and Warden of the Choristers.
WORCESTER. **Hanley Castle.**				
48	20 (elementary).	4	—	—

Number of Boys in the School.	Number of Boys learning Science.	Number of Hours given per Week by each Boy learning Science to that Subject in Class Time.	Number of Hours given per Week by each Boy learning Science to Laboratory or Practical Work.	REMARKS.
WORCESTER—*cont.*				
Kidderminster.				
32	None (at present).	—	—	—
Stourbridge.				
80	20	Three hours -	Irregular - -	WM. J. J. WELCH, M.A., M.D., &c., Head Master.
YORK.				
Giggleswick.				
115	57	The two highest classes, six hours. The two next, four hours.	Each boy in the two highest classes two hours, in other classes one hour. But in special cases senior boys give much more time both to Science work generally, and to practical work in particular.	G. STYLE.
Halifax.				
65	None - -	—	—	THOMAS COX. Halifax, 18th Nov. 1874.
Kirkby Ravensworth.				
35	15	One hour.	—	—
Kirkleatham.				
27	Not specially taught.	Physical Geography, one lesson per week.	None - -	THOMAS BLAND, Master.
Leeds.				
218	130	96 boys 1 hour. 23 boys 2 hours. 11 boys 6 hours. 130	Three, but only four boys do practical work.	W. G. HENDERSON, D.C.L., Head Master. 17th Nov. 1874.
Mirfield.				
36	12	Six, 1½ hours. Six, 3 hours.	Nil.	—
Pocklington.				
40	12	Four.	—	—
Ripon.				
66	Chemistry, 66 Physical Geography, 54	2 hours by 40 boys. 1¾ " by 25 boys. 6 " by 1 boy.	One hour by six boys.	—
Sedbergh.				
21	—	—	—	HENRY GEORGE DAY, M.A., Head Master.
Wakefield.				
45	None specially.	—	—	—
York (Archbishop Holgate's School).				
129	They all learn Mathematics more or less, but we have not found it compatible with the discharge of the regular School work, to give any attention to Chemistry or Science, in the sense in which I believe you mean it.	—	—	R. DANIEL, B.D., Head Master. York, Nov. 18th 1874.
Clifton (St. Peter's).				
162	36	17 boys learn Geology twice a week, ¾ of an hour each lesson, 12 once a week. There is also a voluntary Chemistry (practical) Class, twice a week, out of school hours. This averages about 12 to 14 boys, but about half of them will be members of the Geology classes. The Chemistry lessons are one hour each.		—

ANALYSIS OF THE RETURNS RECEIVED IN ANSWER TO THE SECRETARY'S LETTER OF THE 16TH OF NOVEMBER 1874.

Returns sent out.	Returns received back.	Number of Schools in which Science is Taught.	Aggregate Number of Boys in the Schools.	Number of Boys Learning Science.	Number of Hours given per Week to Science, as far as the Information received with regard to the Time given by the Boys to Science can be tabulated.
128	87	57	8,945	2,430	Half an hour per week in 3 schools. 1 hour per week in 7 schools. 1½ hour ,, 5 ,, 2 hours ,, 16 ,, 3 hours ,, 9 ,, 3½ hours ,, 2 ,, 4 hours ,, 10 ,, 5 hours ,, 4 ,, 6 hours ,, 2 ,, 10 hours ,, 2 ,,

LONDON:
Printed by George E. Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

33

SEVENTH REPORT

OF THE

ROYAL COMMISSION

ON

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1875.

[C.—1297.] *Price* 10*d*.

CONTENTS.

	Page
COMMISSIONS	iii
REPORT	1
APPENDICES	41

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

Victoria, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Right Trusty and Right Entirely Beloved Cousin William Duke of Devonshire, Knight of Our Most Noble Order of the Garter,—Our Right Trusty and Entirely Beloved Cousin Henry Charles Keith Marquess of Lansdowne,—Our Trusty and Wellbeloved Sir John Lubbock, Baronet,—Our Trusty and Wellbeloved Sir James Phillips Kay-Shuttleworth, Baronet,—Our Trusty and Wellbeloved Bernhard Samuelson, Esquire,—Our Trusty and Wellbeloved William Sharpey, Esquire, Doctor of Medicine,—Our Trusty and Wellbeloved Thomas Henry Huxley, Esquire, Professor of Natural History in the Royal School of Mines,—Our Trusty and Wellbeloved William Allen Miller, Esquire, Doctor of Medicine, Professor of Chemistry in Kings College, London,—and Our Trusty and Wellbeloved George Gabriel Stokes, Esquire, Master of Arts, Lucasian Professor of Mathematics in the University of Cambridge, Greeting:

Whereas We have deemed it expedient for divers good causes and considerations that a Commission should forthwith issue to make Inquiry with regard to Scientific Instruction and the Advancement of Science and to Inquire what aid thereto is derived from Grants voted by Parliament or from Endowments belonging to the several Universities in Great Britain and Ireland and the Colleges thereof and whether such aid could be rendered in a manner more effectual for the purpose.

Now Know Ye that We reposing great Trust and Confidence in your Ability and Discretion have nominated constituted and appointed and do by these Presents nominate constitute and appoint you the said William, Duke of Devonshire—Henry Charles Keith, Marquess of Lansdowne—Sir John Lubbock—Sir James Phillips Kay-Shuttleworth—Bernhard Samuelson—William Sharpey—Thomas Henry Huxley—William Allen Miller—and George Gabriel Stokes—to be Our Commissioners for the purposes of the said Inquiry.

And for the better enabling you to carry Our Royal Intentions into effect We do by these Presents authorize and empower you or any three or more of you to call before you or any three or more of you such persons as you may judge necessary by whom you may be the better informed of the matters herein submitted for your consideration and also to call for and examine all such Books Documents Papers or Records as you shall judge likely to afford you the fullest information on the subject of this Our Commission and to Inquire of and concerning the Premises by all other lawful ways and means whatsoever.

And Our further Will and Pleasure is that you or any three or more of you do Report to Us under your Hands and Seals (with as little delay as may be consistent with a due discharge of the Duties hereby imposed upon you) your opinion on the several matters herein submitted for your consideration, with power to certify unto Us from time to time your several proceedings in respect of any of the matters aforesaid, if it may seem expedient for you so to do.

And We do further Will and Command and by these Presents ordain that this Our Commission shall continue in full force and virtue and that you Our said Commissioners or any three or more of you shall and may from time to time proceed in the

execution thereof and of every matter and thing therein contained although the same be not continued from time to time by adjournment.

And for your assistance in the execution of these Presents We do hereby authorize and empower you to appoint a Secretary to this Our Commission to attend you whose services and assistance we require you to use from time to time as occasion may require.

Given at Our Court at Saint James's, the Eighteenth day of May 1870, in the Thirty-third year of Our Reign.

By Her Majesty's Command,

H. A. BRUCE.

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Trusty and Well-beloved Henry John Stephen Smith, Esquire, Master of Arts, Savilian Professor of Geometry in Our University of Oxford, Greeting:

Whereas We did by Warrant, under Our Royal Sign Manual, bearing date the Eighteenth Day of May, One Thousand Eight Hundred and Seventy, appoint Our Right Trusty and Right Entirely Beloved Cousin, William, Duke of Devonshire, Knight of Our Most Noble Order of the Garter, Our Right Trusty and Entirely Beloved Cousin, Henry Charles Keith, Marquess of Lansdowne, together with the several Gentlemen therein named, to be Our Commissioners to make Inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from Grants voted by Parliament, or from Endowments belonging to the several Universities in Great Britain and Ireland, and the Colleges thereof, and whether such aid could be rendered in a manner more effectual for the purpose: And whereas since the issue of the said Warrant William Allen Miller, Doctor of Medicine, one of the Commissioners thereby appointed, hath deceased:

Now Know Ye, that We, reposing great Trust and Confidence in Your Zeal, Discretion, and Integrity, have authorized and appointed, and do by these Presents authorize and appoint you the said Henry John Stephen Smith to be a Commissioner for the purpose aforesaid, in addition to, and together with, the Commissioners now acting under the above-mentioned Royal Warrant.

Given at Our Court at Saint James's the First Day of December 1870, in the Thirty-Fourth Year of Our Reign.

By Her Majesty's Command,
H. A. BRUCE.

Professor Henry John Stephen Smith, M.A.,
To be a Commissioner for inquiring into
Scientific Instruction and the Advancement of Science.

SEVENTH REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

May it please Your Majesty,

We, the Commissioners appointed by Your Majesty to make Inquiry with regard to Scientific Instruction and the Advancement of Science, and to Inquire what Aid thereto is derived from Grants voted by Parliament, or from Endowments belonging to the several Universities in Great Britain and Ireland, and the Colleges thereof, and whether such Aid could be rendered in a manner more effectual for the purpose, humbly beg leave to present to Your Majesty, in continuation of our former Reports, the following Report on the University of London; on the Universities of Scotland (Edinburgh, Glasgow, St. Andrew's, and Aberdeen); on the University of Dublin and Trinity College; and on the Queen's University in Ireland.

As in our Third Report we have dealt with The Universities of Oxford and Cambridge, and as in our Fifth Report we have referred to the Arrangements made by The University of Durham for the Promotion of Scientific Instruction at Newcastle-on-Tyne, the present Report will conclude that part of the Inquiry entrusted to us which relates to the Universities in Great Britain and Ireland and the Colleges thereof.

I.—The University of London.

1. The University of London was founded by Royal Charter, on the 28th of November, 1836, for Objects which are best expressed in the words of its Original Charter:

"Deeming it to be the duty of our Royal Office, for the Advancement of Religion and Morality, and for the Promotion of Useful Knowledge, to hold forth to all classes and denominations of our faithful subjects, without any distinction whatsoever, an encouragement for pursuing a regular and liberal Course of Education; and considering that many persons do prosecute or complete their studies both in the Metropolis and in other parts of the United Kingdom, to whom it is expedient that there should be offered such facilities, and on whom it is just that there should be conferred such distinctions and rewards, as may incline them to persevere in these their laudable pursuits; further know that for the purpose of ascertaining, by means of Examination, the persons who have acquired proficiency in Literature, Science, and Art, by the pursuit of such course of education, as evidence of their respective attainments, and marks of honour proportioned thereunto, we do will, grant, declare, and constitute our right trusty and right well beloved cousin, William Cavendish Earl of Burlington [with 37 others], one Body Politic and Corporate, by the name of 'The University of London.'"

2. The Governing Bodies of the University are the Senate, and the Convocation. The Senate consists of the Chancellor, Vice-Chancellor, and Fellows The Fellows (36 in number, exclusive of the Chancellor and Vice-Chancellor for the time being) are appointed partly by the Crown and partly by the Members of the Senate under the powers granted by the Charter. The following Graduates of the University constitute the Convocation of the University, viz., all Doctors of Law, Doctors of Medicine, and Masters of Arts; all Bachelors of Law of two years' standing, all Bachelors of Medicine of two years' standing, all Bachelors of Arts of three years' standing, all Doctors of Science, all Bachelors of Science of three years' standing; and also all Graduates holding other Degrees recognised as qualifications for admission to Convocation by resolution of Convocation.

3. The whole of the annual expenses of the University are provided for in the Civil Service Estimates, the Estimates for the financial year 1874–75, being 9,861*l*. The fees received by the University are paid into the Exchequer: the sum thus paid in for the same year is given in the Appendix, together with the annual expenses for 1875–76.

The sum paid in was 4,202*l*. 10*s*. 10*d*., *see* Appendix I., pp. 43, 44.

4. That the Government which founded the University desired specially to encourage the introduction of Scientific Study into General Education, may be inferred from the character of the original Body of Fellows; which included many names distinguished in Science, as well as many eminent members of the Medical Profession.

5. The Senate was not originally empowered to grant any other Degrees than those of Bachelor and Master of Arts, Bachelor and Doctor of Laws, and Bachelor and Doctor of Medicine.

6. Certificates of Studentship in some one or more of the affiliated Colleges or Medical Schools were required from all Candidates for Examination; and on the Report of the Senate to the Home Secretary, from time to time, the list of such affiliated Institutions might be varied, altered, or amended.

7. The Examinations have from the first been conducted by Examiners appointed by the Senate.

8. In proceeding to frame a Curriculum of Study for Degrees in Arts and Medicine (Degrees in Laws being originally conferred only upon such as had previously Graduated in Arts), the Senate determined to institute a Matriculation Examination, which should be the test of the candidate's qualification to enter upon a course of Academical Study for either of such Degrees. This Examination included, from the first, not merely Classics, Mathematics, and English, but also an Elementary Knowledge of either Natural Philosophy, Chemistry, or Natural History; and a further encouragement to the study of these Departments of Science was given by subsequent Honours Examinations.

9. The value attached to this Matriculation Examination, as a test of a good School Education, is increasingly shown by the large number of Candidates (now exceeding 1,000 annually) who present themselves at it; a considerable proportion of these having no intention of proceeding to any Degree.

10. No practical Examination was originally instituted at Matriculation, and no change in this respect has been hitherto made. It is evident that there would be considerable difficulty in organizing such an examination for five or six hundred candidates. But there can be no doubt that if this difficulty could be overcome, the enforcement of a practical test would accelerate the introduction of Practical Work into School Teaching, and would thus exert a very favourable influence on the progress of Scientific Education.

11. The Curriculum for the Degree of Bachelor of Arts included Animal Physiology, with Classics, Mathematics, and Mental Philosophy, as subjects of the Pass Examination; and Honours Examinations were instituted in Chemistry, Animal Physiology, and Vegetable Physiology with Structural Botany.

12. The First Examination for the Degree of Bachelor of Medicine included Chemistry and Botany, in both which subjects the examination was practical as well as written and oral. A subsequent Honours Examination was held in Chemistry, to which was attached an Exhibition of 30*l.* per annum for two years. And an Honours Examination was held in Botany.

13. In the Second Examination for the Degree of Bachelor of Medicine, Physiology (with Comparative Anatomy) took equal rank with Medicine, Surgery, and Midwifery; and was the subject of a subsequent Honours Examination, to which was attached a Scholarship of 50*l.* per annum for two years, with a gold medal and the style of University Medical Scholar.

14. No material change in these arrangements took place until the grant of a New Charter in the year 1858, by which the University was empowered to confer the several degrees of Bachelor, Master, and Doctor, in Arts, Laws, Science, Medicine, Music, and in such other Departments of Knowledge (except Theology) as the Senate might determine. And the same Charter provided that persons not educated in any of the affiliated Institutions, might be admitted to examination for any of the Degrees conferred by the University, other than Medical Degrees.

15. Before the terms of this Charter were finally settled, a Memorial had been presented to the Senate, signed by 20 of the most eminent Scientific Men in the Metropolis, urging the propriety of establishing Degrees in Science, and a Committee of the Senate, which included Dr. Arnott, Mr. Brande, and Mr. Faraday, with the subsequent addition of Mr. Hopkins, had been appointed for the consideration of the subject. In the following year (1859), the Degrees of Bachelor and Doctor in Science were instituted, under Regulations which, with some alterations in detail, remain in force at the present time.

16. The principle on which the Curriculum of Study for the Degree of Bachelor in Science was framed, was that of laying a broad foundation of Scientific Culture, upon which the student might advantageously base his acquirements in whatever department of Science he might choose as his special pursuit. The First (Pass) Examination for the

Degree of Bachelor of Science includes Pure Mathematics, Experimental Physics, Inorganic Chemistry, Zoology, and Botany. Subsequent Honours Examinations are held in these several branches of knowledge; an Exhibition of 40*l.* per annum for two years being awarded to the highest proficient in each, provided that he is found deserving of it. The competition for the Exhibition in Mathematics is open also to Candidates who have passed the First Examination for the Degree of Bachelor of Arts; and the competition for the other Exhibitions is open also to Medical Candidates.

17. The First Examination for the Degree of Bachelor of Science, with the omission of Mathematics, under the style of the Preliminary Scientific Examination for the Degree of Bachelor of Medicine, is now imposed on all Candidates for degrees in Medicine, as a preliminary to the proper Medical Curriculum; the subjects of Inorganic Chemistry and Botany being omitted from the First Examination for the Bachelor's Degree, while Physiology is now transferred to it from the Second. All Medical Candidates are required to go through a Practical Examination in Chemistry; and it is the intention of the Senate to impose this test on Candidates for Degrees in Science also. The Examinations in Zoology and Botany have from the first been partly practical.

18. The Second (Pass) Examination for the Degree of Bachelor of Science includes Mechanical and Natural Philosophy, Organic Chemistry, Geology and Palæontology, Animal Physiology, and Logic and Moral Philosophy. Subsequent Honours Examinations are held in these several branches of knowledge; Scholarships of 50*l.* per annum for three years (the competition for which is open also to candidates who have passed the Second Examination for the Degree of Bachelor of Arts) being awarded to the highest proficients in Mathematics and in Logic and Moral Philosophy respectively; and Scholarships of 50*l.* per annum for two years being awarded to the highest proficients in Chemistry, Zoology (including Physiology), and Geology and Palæontology respectively.

19. The Programme of Subjects for the Degree of Doctor in Science, on the other hand, was framed with a view of encouraging the highest proficiency in some special Branch of Knowledge; the candidate being expected to be so fully conversant with the principal subject he may select, as to be able to go through any test (whether by theoretical or practical Examination) of his acquirements in it that can be fairly applied. Sixteen Primary Branches are specified; but several of these are again subdivided, and others may be treated in different ways, at the option of the Candidate.

20. The total number of Candidates who have obtained the Degree of Bachelor in Science up to the present time is 157; the number of those who have obtained the Degree of Doctor in Science is 21, of whom 11 presented themselves in one or other of the Departments of Chemistry.

21. In our Third Report we have suggested that a Doctorate in Science should be established in the Universities of Oxford and Cambridge, and we have expressed the opinion "that Candidates for this Degree should not merely show proficiency of know-"ledge as tested by Examination, but should also offer some Original Contribution to "Science." This principle has already been adopted by the University of Edinburgh, and we think that the Senate of the University of London would do well to consider whether they should not also award the Degree of Doctor of Science only to those who have given proofs of the desire and the capacity to make some addition to Scientific Knowledge.

Third Report, p. xiii.

See para. 40.

II.—The Universities of Scotland.

GENERAL REMARKS.

22. The four Scottish Universities were, as lately as 1863, the subject of an Inquiry, conducted, at considerable length and with great minuteness, by Commissioners appointed under the Universities (Scotland) Act of 1858. The powers given to the Commissioners included the Arrangement of the Financial Affairs of the several Universities and Colleges; the Foundation of new Professorships; the Regulation of the Course of Study and of Examinations for Degrees; and the Revision of Foundations. These powers were, however, conferred upon the Commissioners on the understanding that the additional sum to be provided by Parliament for the four Universities was not to exceed 10,000*l.* a year, and there can be no doubt that in making the Recommendations contained in their Report, they were influenced, not only by the ascertained wants of the Universities, but by the consciousness that their expenditure was to be confined within this limit. See Letters in Appendix II., p. 44.

23. We have not thought it necessary to follow the Report of the Commissioners through its various details. It is, however, important that we should point out the position assigned by them to Science in the System of Education enjoined by their Ordinances.

General Report of the Commissioners under the Universities (Scotland) Act, 1858, p. xxvii.

24. The fourteenth Ordinance, which applies to the four Universities, prescribes for Graduation in Arts "a course extending over four winter sessions, and including "attendance on the Classes of Humanity, Greek, Mathematics, Logic, Moral Philosophy, and Natural Philosophy;" and, in addition to these, "attendance on a course "of English Literature," which previously had not been required in any Scottish University except that of Edinburgh.

Ibid, p. xxix.

25. The Commissioners "considered it necessary to take, as the basis of a System "applicable to the Universities of Scotland, the course of study which had been followed "in those Universities for a very long period;" they dwelt upon the variety of the subjects which that course already embraced, and upon the injurious effect of too large a variety in dissipating the attention of the Students; and they hesitated to recommend any steps which might tend to distract the attention of the Student still further.

Ibid, p. xxix.

26. They were, however, of opinion that it was impossible to dispense with any of the branches of study already embraced in that course. "No one," they said, "who "is competent to form an opinion on such a question, could doubt the propriety "of making Classical Learning the Foundation of an University Course." Again, the historical distinction of the Scottish Universities as "Seminaries of Learning "for the cultivation of the various branches of Mental Philosophy," rendered the Commissioners unwilling to assign to it a position less considerable than that which it had hitherto occupied. So, too, the study of Mathematics, which, under the terms of Ordinance 14, includes Pure Mathematics and Natural Philosophy, appeared to form an essential subject. Finally, "considering the importance which belongs "to the study of the English Language and Literature as part of a liberal education," and the success of the Literature Classes already in existence, although not compulsory, in the different Universities, the Commissioners "did not hesitate to prescribe, over "and above the three original subjects, attendance on the Language and Literature "Course to all Candidates for Degrees [without Honours] in Arts." Ibid, p. xxx. Ibid, p. xxx.

Ibid, Appendix, p. 22.

27. These four subjects once admitted to the curriculum, the Commissioners were unwilling, unless the Universities themselves should think it expedient, to require attendance on a Natural Science Course (including in that term Geology, Zoology, Chemistry, and Botany) in addition to the subjects prescribed as essential by Ordinance 14.

28. Previously to this, however, attendance at Lectures on a branch of Natural Science, either Chemistry or Natural History, had been included in the course of study at the Universities of St. Andrew's and Aberdeen, and representations were addressed to the Commissioners by gentlemen connected with the latter University. In consequence of these representations a fresh Ordinance, No. 18, was issued, sec. 4 of which empowers the University Court of each University to require all Candidates for Graduation to give attendance on the Lectures of any one of the Professors of Natural History, Chemistry, or Botany, whose lectures are included in the Department of Honours in Natural Science. The University of Aberdeen is the only one which has taken action under this Ordinance. Ibid, Appendix, p. 30.

Ibid, Appendix, p. 23.

29. For the purposes of Graduation with Honours, Ordinance 14 permits a student to select any one, or more, of the four following Departments:—

(1.) Classical Literature.

(2.) Mental Philosophy; including Logic, Metaphysics, and Moral Philosophy.

(3.) Mathematics; including Pure Mathematics and Natural Philosophy.

(4.) Natural Science; including Geology, Zoology, Chemistry, and Botany.

30. In each of the first three of these Departments two Grades of Honour are recognised. In the Department of Natural Science, however, one Class only was instituted by the Commissioners, in the anticipation that, for some time, fewer candidates would present themselves in this than in the other Departments.

31. The effect of this arrangement has been stated to us by Dr. Young, the Professor of Natural History in the University of Glasgow:—

> "The understanding amongst the Professors, both in Glasgow and, I believe, also in Edinburgh, is, that the limitation to one class of Honours in Science means, practically, that the candidate shall pass simply. We require two classes of Honours in Arts, and a pass is all that is requisite, under the Ordinances, in Natural Science, so that hitherto there has been, one might almost say, no inducement to Students to attend the Classes in Natural Science."

Qu. 9578.

32. In order to prevent this discouragement of the study of Natural Science, we Recommend that for the future two Classes be recognised in the Natural Science Honours List.

33. We have already, in our Report on the Universities of Oxford and Cambridge, expressed the opinion that, just as a knowledge of Language and Literature is indispensable to the Science Student, so also some acquaintance with Natural Science is essential to the completeness of that education of which a Degree in Arts given by one of the National Universities is accepted as a proof.

Third Report.

We observe with satisfaction that this principle has been adopted by the Scottish Universities, as the chief Departments of Experimental Physics are included under the head of Mathematics, which is one of the compulsory subjects for the Degree in Arts. We would suggest that the Student should be allowed to show the required proficiency, whether in Science or Literature, by passing an Examination at such a period in his University career as will enable him, in the latter part of his Academical Course, to devote his attention systematically to a particular group of subjects.

34. A large proportion of the Students at the Scottish Universities attend the Courses with the object of preparing themselves for a Profession. Their education is, not unfrequently, procured with difficulty, and at a sacrifice by which their resources are severely taxed. "It is undoubted," say the Commissioners of 1858, "that a very large "number of the Students in the Scotch Universities are in exceedingly poor circum- "stances. Many of them engage during the summer in teaching and other employ- "ments, in order to gain the means of supporting themselves at the University during "the winter; and the Professors receive, in the last few weeks of the Winter Session, "frequent applications from Students to dispense with their longer attendance, on "account of their scanty funds being already exhausted."

General Report of the Scottish Universities Commission, p. xxx.

It follows from this that the payments which the Universities feel themselves justified in demanding from their Students are small, and the resources of the Universities themselves, in so far as they are derived from fees, are slender in proportion. Nor will their endowments bear comparison with those of the sister Universities in England. It was no doubt upon these grounds that Parliament, upon the occasion of the passing of the Universities (Scotland) Act, agreed to make, from public funds, a contribution in Aid of these Universities. An account of the application of these Grants, so far as they are available for Science Teaching, will be subsequently given.

Qu. 9785.

35. In Universities accessible to, and widely used by, the middle classes, it is not surprising that, side by side with a system of education which has been successful in producing Literary and Scientific Culture of the highest order, there should exist a body of teaching more utilitarian in its character, and assigning a prominent position not only to Pure but to Applied Science.

Thus, in each of the Universities of Edinburgh, Glasgow, and Aberdeen, there is a complete Medical School, at which a large body of Students are engaged in qualifying themselves for the Medical Profession, by attendance on the Lectures of the Professors, and by Clinical Instruction in the Hospitals. In the University of St. Andrew's there is a Medical Faculty but no Medical School.

Commissioners' Report, p. xxxiv. Qu. 9787–8. The St. Andrew's University Calendar for 1874–75, p. 45.

Again, both in Edinburgh and in Glasgow there are Chairs of Engineering, of which an account will be found in a subsequent part of this Report. These Chairs, as well as a Chair of Agriculture in the University of Edinburgh, the teaching of all of which has a decidedly technical character, are directly endowed by Government from Public Funds, while they share the advantages which have been secured to the Universities of Edinburgh and Glasgow by the expenditure of large sums of money voted by Parliament for the erection of University buildings.

EDINBURGH.

The Scientific Curriculum.

36. The position assigned to Science in the University of Edinburgh has, in so far as it enters into the Examination for Graduation in Arts, been already described in the general account which we have given of Ordinance 14 of the Commissioners of 1858.

37. The Scientific Subjects taught in connexion with the Medical School may be divided into three groups :—

A. The general Sciences, in which all Medical Students are instructed and examined in a manner to be presently described.

B. The Sciences more especially appertaining to Medicine, such as Anatomy, Physiology, and Pathology.

C. The Special Medical Subjects themselves, such as the Practice of Medicine, Surgery, and the Clinical Courses.

38. All Candidates for the Degrees of Bachelor and Doctor of Medicine are required to pass an Entrance Examination, including, among other subjects, Mechanics and Natural Philosophy. They then undergo a Preliminary Examination in Botany, Natural History, and Chemistry; and Candidates obtaining more than 75 per cent. of the marks are placed in the Honours List. This Examination is irrespective of those in the more strictly Medical Departments of Study included in the second and third of the above Groups. It is, however, proper to point out that doubts have been thrown by one of the Witnesses whom we have examined (the Professor of Natural Philosophy) upon the sufficiency of these Examinations for the purposes of his own Department. Mr. Tait states that "there is no provision in the University Regulations for attendance on Natural "Philosophy by Medical Students. They are required to pass an exceedingly slight "Entrance Examination in the merest elements of what is commonly called Mechanics, "and there is also another Examination on what is called Natural Philosophy, but it "would be absurd to say that the so-called elements of Natural Philosophy in which "they are examined embrace the whole subject." Qu. 9461.

39. The Examinations for Degrees in Science are described in the following extracts from a Statement furnished to us by a Committee of Senatus of the University.

Minutes of Evidence, Vol. II., App. V., p. *12.*

"Candidates for the Degrees of Bachelor and Doctor of Science, in the Department of Physical and Natural Science, undergo a Preliminary Scientific Examination in Mathematics, Natural Philosophy, Chemistry, Zoology, and Botany. This examination is called the First Bachelor of Science Examination. The candidate may then select one of the following groups for the Second Examination, on passing which he attains the Degree of Bachelor of Science :—

"(*a.*) The Mathematical Sciences - - - -	Higher Mathematics. Natural Philosophy.
"(*b.*) The Physical Experimental Sciences - - - -	Experimental Physics. Chemistry.
"(*c.*) The Natural Sciences - - - -	Zoology, Botany. Physiology, Geology."

"For the Degree of Doctor of Science, the candidate must profess that Science which he intends to be the special object of his future study, and must further select a particular branch of it in which he believes himself to have attained a considerable knowledge."

Edinburgh University Cal. 1875–76, p. 128; and App. III., p. 47.

40. Since the foregoing information was received from the Authorities of the University of Edinburgh, a Regulation has been made that each Candidate for the Degree of Doctor of Science must submit a Thesis containing "Some Original Researches on the subject of his intended examination, and such Thesis must be approved before the candidate is allowed to proceed to examination."

41. In addition to the above General Degree in Science, there is also a Special Degree in the Department of Engineering, which is thus referred to in the same document :—

"Candidates for the Degrees of Bachelor and Doctor of Science in the Department of Engineering must undergo a Preliminary Examination in Mathematics, Natural Philosophy, and Chemistry. They may then proceed to the Second Bachelor of Science Examination in the following subjects :—Mathematics applied to Mechanics, Engineering, and Mechanical Drawing. On passing this Examination they receive the Degree of Bachelor of Science in Engineering. The candidate for the Degree of Doctor of Science in Engineering must profess one, and not more than one, of the subdivisions in each of the two following groups of subjects :—

"I.—Practical Engineering	(*a.*) The design of machinery, with complete drawings, specifications, and estimates. (*b.*) The preparation of designs, specifications, and estimates for Civil Engineering work.
"II.—Applied Science -	(*a.*) Applied Mathematics. (*b.*) Chemistry. (*c.*) Geology. (*d.*) One branch of Natural Philosophy. (*e.*) Telegraphy.

"The examinations in Group I. consist in requiring the actual execution of the specified work. The candidate is examined orally in connexion with the work submitted as his own."

App. III., p. 53.

42. To the Departments in which Degrees in Science may be obtained, has, we also learn, been recently added a Department of Public Health, an account of which will be found in the Appendix to this Report.

The System of Examination.

43. We desire, before proceeding further, to refer to the Evidence which we have received with regard to the manner in which the Examinations for Graduation are conducted in this University. Its means have not admitted of payments to Special Examiners for the Science Degree, and the Examinations have consequently been hitherto conducted almost entirely by the Professors themselves, who receive no remuneration for their labour as Examiners.

Qu. 9329.

44. The Examination for Degrees in the case of the Faculty of Medicine was, at the time when we received Evidence from this University, entrusted to all the Professors in the Medical Faculty, with three Non-Professorial Examiners, elected by the University Court, and paid by a Parliamentary Grant of 100*l.* a year each.

Qu. 9333. Qu. 9380.

45. This arrangement was not one with which the University Authorities were content. “Many of my Colleagues,” says the Professor of Anatomy, “and myself also are of opinion that our System of Examination would be improved if we had more than three Non-Professorial Examiners specially qualified. We are by no means indisposed to receive additional examiners *ab extra*, supposing that any arrangement could be made for properly remunerating them.” With reference to this subject, the Professor of Chemistry stated to us that all his Colleagues “desired an increase in the number of Non-Professorial Examiners, because, as they are not appointed as Examiners in any one Department, it must frequently happen that no one of them is specially acquainted with the subject” in which he is called upon to examine.

App. III., p. 51.

46. Since this Evidence was given, the University Court has, in the case of the Medical Examinations, thoroughly recognised the principle of associating with the Professors additional Examiners, unconnected with the Professoriate, and has introduced a large number of additional Examiners. It would be very desirable that a similar improvement should be introduced into the other Scientific Examinations of the University. We learn that the question of appointing additional Examiners, not Professors, for the Degrees in Science, has been under the consideration of the University Court, but that this useful reform is still likely to be retarded, owing to want of funds. We should regard it as a fortunate result if, out of any assistance granted to the University, funds could be appropriated for this object.

Financial Statement.

Qu. 9269.

47. The capital of the University was stated, in 1872, to amount to 144,951*l.* Of this capital, the sum of 103,556*l.* is specially limited to certain uses. The income available for other than these special uses consists of—

1. Interest on the difference between the above sums.
2. Matriculation and Graduation Fees.
3. The Annual Grant from Government.
4. Sundry minor receipts.

From these various sources the University derives an income of 7,375*l.*, of the distribution of which we received the following account:—

Qu. 9270.

“The general administration of the University (viz., the salary of the Secretary, the salary of the Clerk, the salary of the Factor, that is our man of business, the salary of the Dean of the Medical Faculty, of the Dean of the Faculty of Arts, and the Editing of the Calendar) costs 981*l.* a year: the Library absorbs 1,584*l.* annually; 217*l.* is allowed for the support of the Anatomical and Botanical Museums; the repair, cleaning, heating, and lighting of the buildings, the poor rate and water rate, and insurances, absorb 1,827*l.*; on the general service of the University, in the shape of door-keepers, warders, and so on, 595*l.* is spent; 1,465*l.* for Class Assistants and class expenses; 366*l.* for printing and advertisements; 207*l.* for prizes; 18*l.* for graduation expenses, and 41*l.* for sundries, making altogether 7,301*l.* The balance of unexpended income for the year 1871 was only 74*l.*”

48. Out of the income derived from the capital sum of 103,556*l.*, the interest of 24,056*l.* is applied under special bequests to the Endowment of five Chairs, including one of Natural History; while the interest of 54,720*l.* is set apart for Bursaries, Scholarships, and Fellowships, of which, however, one only is given in the Medical, and three only in the Natural Science School, the remainder being associated with the Faculties of Arts and Theology.

49. We have been supplied with the following Statement of the Funds Annually applied to Scientific Instruction, whether from Endowments or Parliamentary Grants or from the general University Fund.

Minutes of Evidence, Vol. II., App. V., pp. 10, 11.
See App. II., p. 45.

FUNDS ANNUALLY APPLIED TO SCIENTIFIC INSTRUCTION, DERIVED FROM ENDOWMENTS OR PARLIAMENTARY GRANTS.

Natural Philosophy.

		£	s.	d.
Endowment of Chair	Leith Harbour Annuity	22	4	4
	Parliamentary grant	180	0	0
Class Assistant—Parliamentary grant		100	0	0

Practical Astronomy.

	£	s.	d.
Endowment of Chair—Parliamentary grant	[*]300	0	0

Agriculture.

		£	s.	d.
Endowment—Pulteney bequest, 50*l.*		350	0	0
Granted in 1868	Highland and Agricultural Society, 150*l.*			
	Parliamentary grant, 150*l.*			

Music.

		£	s.	d.
Endowment of Chair from funds left for that purpose by General Reid	Salary of Professor	420	0	0
	Class Expenses:—			
	Assistants and instruments, &c.	300	0	0
	Annual Concert	300	0	0

Engineering.

		£	s.	d.
Endowment of Chair	Parliamentary grant	200	0	0
	Sir David Baxter's Foundation	200	0	0
Class Expenses—Sir David Baxter's Foundation		40	0	0

Chemistry.

	£	s.	d.
Endowment of Chair—Parliamentary grant	200	0	0

Chemical Laboratory.

From the Hope Prize Fund, a Biennial Travelling Scholarship, tenable for one year, value 100*l.*	50*l.* per ann.

Physiology.

	£	s.	d.
Endowment of Chair—Parliamentary Grant	150	0	0

Anatomy.

Neither endowment nor Parliamentary grant.

Natural History and Mineralogy.

		£	s.	d.
Endowment of Chair	Parliamentary grant	160	0	0
	Thompsonian bequest	35	15	2

Geology.

		£	s.	d.
Endowment of Chair	Sir Roderick Murchison's Foundation	200	0	0
	Parliamentary grant	200	0	0
Class expenses—Sir Roderick Murchison's Foundation		40	0	0

Botany.

		£	s.	d.
Endowment of Chair	Parliamentary grant	160	0	0
	Leith Harbour Annuity	40	0	0

FUNDS ANNUALLY ALLOCATED FROM THE GENERAL UNIVERSITY FUND TO SCIENTIFIC INSTRUCTION.[†]

Natural Philosophy.

	£	s.	d.
By Ordinance of Commissioners—			
Class expenses	100	0	0
Annual vote of Senatus—			
Mechanical Assistant	100	0	0

Practical Astronomy.

None.

Agriculture.

	£	s.	d.
Annual vote of Senatus—			
For class expenses	5	0	0

Music.

None.

Engineering.

	£	s.	d.
Annual vote of Senatus for prizes	5	0	0

Chemistry.

	£	s.	d.
By Ordinance of Commissioners—			
Salaries of Assistants	200	0	0
Class expenses	[‡]100	0	0

---

[*] This sum is independent of other emoluments which the Professor of Practical Astronomy receives as Astronomer Royal for Scotland; the two offices being, by his Commission, conjoined.

[†] Conditional on the state of the General University Fund, which is principally made up from Matriculation and Graduation fees, and depends, therefore, on the number of students attending at the University, and on the number graduating. There are many other unavoidable charges on this fund, such as the maintenance of the College buildings, salaries of librarians, clerk, servitors, &c., &c., so the amount available for scientific purposes is very inadequate.

[‡] The salaries of Assistants in the Chemical Department amount to 434*l.*, and the excess of this over the 200*l.* allowed is paid by the Professor.

Physiology.

	£	s.	d.
By annual vote of Senatus—			
Assistant	100	0	0
Class expenses	50	0	0

Anatomy.

	£	s.	d.
By Ordinance of Commissioners—			
Class expenses and salary of Demonstrator of Anatomy	*200	0	0

Natural History and Mineralogy.

	£	s.	d.
Annual vote of Senatus—			
Class Assistant	30	0	0

Geology.

None.

Botany.

	£	s.	d.
Annual vote of Senatus for Assistant	25	0	0
„ „ for Herbarium (including class drawings)	50	0	0

50. A Statement of the total Emoluments of the Professors, inclusive of fees, will be found in the Appendix. It will be observed that there is a great disparity in the amounts received. App. III., pp. 54–58.

51. In the early part of the present century the University received from Government 129,000*l*. towards the erection of the present buildings, which had been commenced with a sum of 30,000*l*. only, raised by public subscription in Scotland. The result of this large expenditure has been to provide the University with buildings containing much excellent accommodation, though, as will be shown by the Evidence to which we shall subsequently refer, they are absolutely insufficient for its present needs.

Number of Students.

52. The number of Students who have Matriculated at the University each year, since 1867, indicates a steady and rapid increase, as will be seen from the following Statement:— Qu. 9287; and see App. III., pp. 62, 63.

1867–68	1,513
1868–69	1,564
1869–70	1,698
1870–71	1,768
1871–72	1,854
1872–73	1,906
1873–74	1,930

The number of Students in the Medical and Engineering Schools during the same period was as follows:—

	No. of Medical Students.	No. of Engineering Students.
1867–68	445	—
1868–69	516	29
1869–70	586	47
1870–71	678	55
1871–72	725	45
1872–73	782	52
1873–74	839	50

53. With regard to the numbers of Students newly joining the different Faculties of the University in the Summer Session, the following Statistics, relating to the last three years, have been placed before us:—

Summer Session.	Faculties of			Total.
	Medicine.	Arts.	Law.	
1872	89	8	9	106
1873	117	6	7	130
1874	128	8	8	144
Totals	334	22	24	380
Average	111	7	8	126

---

* This sum falls much below the annual amount which the Professor is called upon to expend, in order to carry out, in an efficient manner, Instruction in Practical Anatomy.

54. During the Winter Session of 1874–75, the number of Students attending the University Course in the different Faculties has been as follows:—

Faculty of Arts - - - - - -	778
Faculty of Medicine - - -	743
Faculty of Law - - - -	310
Faculty of Divinity -	66
	1,897

Taking the average attendance at the Summer Course, deduced from the foregoing Table, the number of Students attending the University of Edinburgh during the Academical Year 1874–75, may be set down as—

During the Winter Session (actual) - - -	1,897
During the Summer Session (estimate) - -	126
	2,023

App. III., p. 63.

55. The fees paid for the various subjects will be found given at length in Appendix III. to this Report.

Museums and Collections.

56. The Museums and Collections available for Members of this University are as follows:—

1. An Anatomical Museum, the property of the University, maintained by a small grant from the general fund. This Museum is open to the Students and used by them and the Professors. It contains a valuable Collection (used for Teaching Purposes) illustrative of Comparative Anatomy.

2. A Museum of Materia Medica.

3. An Herbarium.

4. The Edinburgh Museum of Science and Art, open to the University under an arrangement made at the time when the Natural History Museum of the University was transferred to the Science and Art Department. Specimens are also collected by the Geological Survey, but there is at present no means of arranging them in such a manner as to render them available for the Purposes of Instruction.

Qu. 9483.

"The Geological Survey," Professor Geikie informs us, "has been prosecuted for about "16 years in Scotland, and every year during that time considerable Collections have "been made to illustrate the Rocks, Fossils, and Minerals of the various districts which "have been under examination by the Survey. These Collections have been to a very "small extent exhibited in the Museum attached to the University; a large portion of "them, all or nearly all the fossils, and a large mass of rock specimens and minerals, "which would be of great value to the public if they were exhibited, to illustrate wide "areas of the country, are at present stowed away in cellars for want of any space "in which to exhibit them."

Deficiencies in respect to Buildings, Assistants, aud Apparatus.

For Schedule of Lectures and Laboratory Instruction, see App. III., pp. 58–62.

57. We have received much Evidence with regard to the Wants of the University, and to the Difficulties under which Scientific Teaching within it appears to labour. These Difficulties are occasioned principally by deficiencies in the accommodation afforded by the present University Buildings, and in the supply of Assistants and Apparatus.

Buildings.

Qu. 9284.

58. There is a complete concurrence of testimony as to the insufficiency of the present building for the work of the University. It is now provided with 18 Lecture Rooms, in which no less than 40 distinct Courses of Instruction have to be conducted. Some of the rooms are used for the Lectures of three different Professors, and it is not matter for surprise, therefore, that this should occasion great inconvenience. The Professor of Pathology has, we are told, "to lecture in a room which is used only one hour before he "enters it by the Professor of Moral Philosophy, and one hour after he leaves it by the "Professor of Geology."

59. The demand which has arisen in all the Departments of Scientific Education for Teaching of a more Practical Character than that with which the public was formerly satisfied, has given additional force to the plea unanimously put forward by the different Professors for accommodation more ample than that which the existing buildings afford. "Class rooms for practical instruction take up," we are reminded, "a large comparative Qu. 9284. "amount of space, because you cannot pack up the Students as you do in a lecture "room; they must have space to move about in."

60. The Professor of Chemistry represents to us that the accommodation at his disposal is not only inadequate, but most inconveniently arranged. The room which is used for the laboratory "was never intended for the purpose. It is dark and ill-ventilated, and Qu. 9356. "altogether unsuitable." The Students in the Practical Classes of this Department have increased from 72 in the Academical year 1861–62 to 140 in the Academical year 1870–71. The University Laboratory is able to accommodate about 12 students only Qu. 9363. at a time, and, owing to this limitation of the space available, it has been found necessary to preclude all but the more advanced Students from Laboratory work.

61. The same want has been felt by the Professor of Natural Philosophy. He found it impossible to obtain space for a Laboratory till 1868, when he was provided with "a "small class-room which had come to be disused, entirely unsuitable, or at least by "no means very suitable for almost any class of experiments." The result of this is that Qu. 9416. when more than 8 or 10 students attend the Laboratory at once, some of them are obliged to work in the Class-room, and some among the Professor's Collection of apparatus. "The "superintendence of groups of students scattered about, with stairs to ascend, and passages between them, is a matter of considerable difficulty, and adds materially to the "labour of teaching."

62. We are informed by the Professor of Geology that his Lecture-Room is not adapted Qu. 9467. for the Purposes of a Natural History Lectureship. Diagrams and models cannot be properly displayed, and "the only table space for the exhibition of specimens is the desk which is used by the Professor of Moral Philosophy." For the storing of the specimens Qu. 9468. themselves there is no accommodation whatever in the lecture-room. A cellar in the S.E. part of the College Buildings has been used for this purpose, but it is inconvenient, owing to deficiency of light, distance from the lecture-room, and difficulty of access. The requirements for the effectual performance of the duties of this Chair are described by Professor Geikie in the following terms:—

> "In order to the effectual performance of the duties of this Chair, I consider it essential, first of all, that Qu. 9469. the Professor should have a separate class room, with a suitable lecture table and wall space, as well as the other accommodation which is usual for illustration of lectures by means of diagrams, models, specimens, and apparatus. In the second place, there is required a retiring room attached to the class room, with sufficient space for cabinets of specimens, diagrams, &c., and with proper light to admit of the examination of the specimens, and also with adequate provision of microscopes, lathes, blowpipes, and other testing apparatus for thorough practical instruction in the subjects of the Chair; for I consider that the duties of this Chair should consist not merely in lecturing, which is all that they can consist of at present, but in practical instruction by examination of specimens, and in the mineralogical part of the Chair by a series of carefully directed lessons in mineralogical research, and especially in research with the blowpipe and with the microscope. At present no provision exists for that practical department."

63. The University Authorities have, however, by no means limited themselves to barren App. III., complaints of their present situation. A Committee was formed for the purpose of for- p. 65. mulating the Requirements of the different Departments, and we have had before us a copy of their Report. It was proposed "to transplant the Medical School from the Qu. 9284. present University Buildings to a new site, so as to leave the present buildings for the other Departments of the University." The University was at this time in treaty "for "the acquisition of a piece of ground excellently situated for the purpose, and hopes "to acquire this ground without much delay." It was contemplated that in the New Buildings the Medical School would require about 60,000 superficial feet, made up as follows: Anatomy, 20,000 square feet; Chemistry, 12,000; Materia Medica, 5,616; Institutes of Medicine (that is, Physiology) 5,500; Pathology, 4,000; Medical Jurisprudence, Surgery, Practice of Medicine, and Midwifery, 3,000 each. The very large amount of space required for Anatomy, includes what is needed not only for Class Teaching Purposes, but also for the Anatomical Museum belonging to the University. This Collection is at present very inadequately accommodated.

64. Such a scheme of extension as that indicated above could obviously not be carried out except at very considerable expense. From the account already given of the financial situation of the University, it will be evident that it has no capital of its own to apply for the purpose of erecting new buildings. "The University," we were told by Pro- Qu. 9295. fessor Turner, by whom the Report was laid before us, "has to ask for money, both "for buying the ground and for building the necessary structures. We propose to go "to the public and endeavour to raise what we can in the way of subscription. But I

" may state that the people of Edinburgh and of the surrounding district have, during " the past four or five years, raised a sum of upwards of 70,000*l.* for building a New " Infirmary, so that the public pocket has been, we think, very materially drained for " that purpose; and although we may raise, and I hope we shall raise, a considerable " sum of money, yet we do not anticipate that we shall be able to collect all that will " be needed, and we are desirous of obtaining aid in this respect from the Govern- " ment." * * *

At a public meeting held in London on December 7, 1874, it was stated by his Royal Highness the Duke of Edinburgh, who presided, that no less than 70,000*l.* had already been subscribed towards the cost of the University Buildings. The necessity for increased accommodation was at the same meeting explained by the Earl of Derby, who stated that at the time when the existing buildings were erected,—

> "The accommodation which it was thought necessary to provide was for a number not much exceeding 600, certainly not exceeding 700 students in all, the number of professors being then 21. At present, as you have heard from his Royal Highness, the number of students falls little short of 2,000, and the number of the professors is 35, and though I cannot actually prove it from figures or facts, I have very little doubt that the still further growth of the University has to some extent been checked by that very great want of space for which we desire to provide a remedy."

At the same meeting, the Right Hon. Lyon Playfair made use of words to the following effect:—

> "As a Professor of lengthened experience, he might be allowed to testify that the Laboratories of Chemistry, Physics, Anatomy, Physiology, and Biology were altogether unworthy of such an important University."

App. III., p. 65. 65. We are informed by the Principal of the University that, since the date of the above proceedings, the subscriptions have increased up to a sum of over 75,000*l.* The site for the new Medical School, and for the University Hall, in immediate proximity to the New Royal Infirmary at Edinburgh, has been purchased for a sum which, with law and other expenses, will reach about 34,000*l.* It will, however, be impossible to complete the buildings, even in the plainest style, under a cost of 76,000*l.*, while the internal fittings are estimated at 20,000*l.* A further sum of 20,000*l.* will, it is contemplated, be required, in order to adapt the old Medical Class Rooms in the present College for the uses to which they will in future be put.

Assistants and Apparatus.

66. The Scientific Professors are much embarrassed by the want of a sufficient number of Assistants. This also is attributable to the Inadequacy of the Resources of the University. Among the powers vested in the Commissioners appointed under the Universities (Scotland) Act, is that " of making Ordinances in order to found new Professorships " where they are required, and to provide for the Appointment of Assistants to such " Professors as from the nature and duties of their Professorships require assistance, " and to provide for the remuneration of such Assistants." Under these powers, a certain number were appointed. The Commissioners state in their Report that they were strongly urged to provide Assistants for a greater number of Chairs, but that they found it impossible with the means at their disposal to do so. (See para. 22.) They were, therefore, compelled to select for such help those Professorships which appeared to them to stand most in need of assistance. The Professors are consequently still either without the necessary staff, or obliged to provide it at their own expense.

67. It is, however, requisite to bear in mind that, in the case of those Professors by whom a special fee is charged for admission to their Practical Classes, apart from that payable for attendance on the Course of Lectures, an increase in the number of pupils, while necessitating increased expense for the payment of Assistants, serves also to increase the emoluments of the Chair.

68. In the University of Edinburgh there are, it appears, three Classes of Assistants:—

1st. Assistants allowed by an Ordinance of the University Commissioners, and associated by them with certain Chairs.

2nd. Assistants appointed by the Professors, whose appointments are confirmed by the Senatus.

(Both these Classes receive their salaries from the general fund of the University, and discharge similar functions.)

3rd. Assistants appointed by the Professors on their own responsibility, and paid by the Professors themselves.

69. The number of Assistants and their emoluments are, as we have already said, often inadequate. Qu. 9301. The Professor of Physiology has only 100*l.* a year allowed for his Assistant, whose time is entirely taken up, and who, during nine or ten months of the year, is

working the greater part of the day. The Professor of Chemistry has four assistants, two of whom are paid at the rate of 100*l.* a year, each, under the Ordinance, the Professor providing from his own resources for the payment of the other two. In addition Qu. 9348. to this he finds himself obliged to increase the salaries allowed under the Ordinance in Qu. 9359. order to obtain the services of properly qualified persons.

70. Several of the Assistants throughout the University receive the very small sum of 25*l.* a year; a remuneration so inadequate for a man who has already been obliged to provide for his own professional training, that its amount can only be explained by the assumption that these appointments are sought for by Science Students on account of the opportunities for improvement which they afford, rather than for the emoluments attached to them.

71. It is of the highest importance that the Scientific Professors should be provided with Assistants qualified, at all events, to take charge, and to make use, of the apparatus and collections entrusted to them. One Assistant, at least, of those attached to each Chair should be competent to relieve the Professor of the routine work of his Practical Classes. These duties cannot be effectually discharged except by a person of some standing and attainments, who has by habit and acquaintance become familiar with the work of the Class and the methods adopted by the Professor in treating his subject. It is idle to expect such qualifications from an Assistant whose services are requited so slenderly as to render him anxious to transfer them as quickly as possible to some better remunerated employment.

72. It is fair to assume that the salaries allowed by the Commissioners of 1858 were fixed with reference to the limitation to which we have already referred in the amount of the Annual Grant. We desire to record our opinion, that, in the present day, they can See para. 22. be no longer expected to command or to retain the services of a properly qualified staff. The Professor of Natural Philosophy has given us the following Evidence on this question:—

> "You are also very much inconvenienced, are you not, by the want of proper assistance?—That again is Qu. 9420. a source of excessively unnecessary labour to myself, owing to the small amount of money which I receive for the payment of a mechanical assistant. I am not speaking of teaching assistance, but simply of assistance in keeping in order and setting up for experiment my apparatus. My difficulty in that respect is very great, but that again is merely a question of money. The mechanical assistant whom I have at the present moment is a man between 70 and 80 years old, who, I may mention, was in Sir John Leslie's service. He was doorkeeper when Sir John was Professor of Mathematics in the University of Edinburgh, and served him as mechanical assistant the whole time he was Professor of Natural Philosophy; and he served the whole or the principal part of his time with Principal Forbes in all his experiments, and he has served me since my appointment to the Chair. This is his 58th session in the University, and he is at present the sole mechanical assistant that I have, seeing that his son is temporarily disabled."
>
> "He is paid by the College, is he not?—Yes, he is paid out of the same fund as that from which I get Qu. 9421. 100*l.* a year for class expenses."
>
> "Have you any teaching assistant?—I have a class assistant, and I have already alluded to his giving Qu. 9422. Tutorial Lectures. He helps me not only by giving those Tutorial Lectures, but also by superintending the Laboratory when I cannot be present myself; and besides that by relieving me of the excessively tedious work of looking over the answers to the examination papers. In the course of his looking over those answers to examination papers merely, he has, on the average, about 1,500 answers to examine once a fortnight. Then he spends the greater part of five hours each day in the Laboratory, in addition to what Tutorial Lectures he is giving for me at the time."
>
> "How is he remunerated?—He gets 100*l.* a year from the Exchequer. I may mention that when you Qu. 9423. contrast the amount of work which he has to do for me with the pay which he receives, it is not at all wonderful that during the short period that I have had such an Assistant, I have had almost every second or third year to train a new one, because the salary is utterly inadequate to the work expected of him."
>
> "Is it not a consequence of so much work falling upon the Professor that he has not sufficient leisure Qu. 9425. for original work?—When matters are at the best, I have very little leisure for nine months in each year; but at the present moment I may say that I have absolutely no leisure at all. * * * *
> I may say that it is hardly possible, without a large sum, to hire a really trained assistant; no improvised assistant would be capable of giving me the least help, and, therefore, during the temporary disablement of my own assistant I must simply do his work myself as well as my own. It would take at least two months or more of training before I could trust a man with the apparatus."

73. On pages *12-14*, Appendix V., Vol. II., will be found a Recapitulation of the Minutes of Evidence, vol. II. principal wants of the University in respect of Scientific Instruction and the Advancement of Science; and it will be observed that the want of increased and better paid assistance felt by the Professors to whose Evidence we have already referred, is experienced in almost every one of those Departments of the University in which Scientific Teaching is carried on. It will be evident from what has been already stated with regard to the finances of the University, that it has no funds out of which these requirements can be sufficiently complied with.

74. The Inadequacy of the Staff of Assistants causes an encroachment upon the time which the Professor might otherwise devote to original work. The poverty of the Laboratory accommodation is also a serious impediment. The Professor of Chemistry stated in Evidence: "Before I became Professor, while I was what we call an Extra Qu. 9367. " Academical Lecturer (which corresponds to the *privat docent* in German Universities),

" at the Laboratory which I had at that time, I had more opportunity for carrying on " original investigations than I have at present in the University; because our space is " insufficient." The Evidence of the Professor of Natural Philosophy, already quoted, is to the same effect.

Eighth Report. 75. We shall deal in a separate Report with the subject of the Endowment of Scientific Research: in connexion with the present branch of our Inquiry, it will be sufficient for us to express our conviction that it is of the highest importance to these National Universities that the amount of work assigned to their Professors should not be such as to render Original Work on their part impossible from mere lack of time and physical strength. In the case of the University of Edinburgh, that time is often taken up, and that strength overtasked, by the performance of duties which a moderately paid assistant is competent to discharge. We have not overlooked the fact that the summer vacation of six months, allowed in this and other Scottish Universities, affords to some of the Professors a long period of continuous relief from the work of teaching. It does not, however, appear to us that this period is excessive, considering that the Lectures are given throughout the whole Session, and that the careful preparation which they require must, to a great extent, take place during vacation time. Others of the Professors are required to give, in addition to their Winter Courses, a Summer Course, and it is obvious that these can have but slender opportunities for Original Work, unless the aid which they receive from Assistants is sufficient to relieve them from a considerable portion of the routine work of their Classes.

Qu. 9349. 76. The Apparatus possessed by the University is very far from being adequate to the Modern Requirements of Scientific Teaching. The Professor of Chemistry is supplied with only "a collection of old apparatus, mostly inapplicable to the purpose, which " belongs to the University, the remains of old collections. There is also a collection of " specimens for the illustration of lectures which was presented to the University by " Professor Playfair when he retired from the chair. The remainder of the apparatus, " both what is used in the laboratory for practical work, and what is used for lecture " purposes," belongs to the present Professor. He purchased what belonged to Professor Playfair, whose private property the apparatus was. The University grant of 100*l.* a year for the purpose of keeping up and renewing the apparatus is insufficient. The same want is also expressed, in the Statement to which we have already referred, on behalf of the Chairs of Natural Philosophy, Practical Astronomy, Engineering, Physiology, Anatomy, Botany, Medicine, Pathology and Clinical Medicine.

Minutes of Evidence, Vol. II., Appendix V., pages *12–14*.

77. The different wants which we have now noticed *seriatim* are thus recapitulated by the Professor of Anatomy in his Evidence:—

Qu. 9312. " If we possessed proper buildings for teaching purposes, if we possessed proper appliances in the way of apparatus, and if we possessed sufficient funds to remunerate and retain about us a good staff of well-qualified assistants, I think that the University would be enabled to develope itself as a teaching body, in connexion with affording general scientific instruction, much more so than it has hitherto been able to do."

Conclusion and Recommendations.

78. The Resources of the University of Edinburgh are comparatively small, and it would be unreasonable to expect from local sources contributions sufficient for the complete removal of the defects which we have noticed.

79. We are, therefore, of opinion that, considering the largely increased numbers of Students attending the University, and the demand now universally made in all the great centres of National Education for Scientific Instruction of a very complete and practical kind, the University of Edinburgh has established a claim to increased assistance from Government.

80. We Recommend that such Assistance should be given, both in the form of a Capital Sum in aid of a Scheme of Extension, such as that to which our attention has been specially directed; and of an Annual Grant sufficient to enable the University to increase the Number, and, in some cases, the Emoluments of Assistants; to make more ample provision of Apparatus for Teaching; and to revise the Salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees.

Fifth Report. 81. We further Recommend, as we have already done in the case of Owens College Manchester, and the Metropolitan Colleges, that the Grant of the Capital Sum in aid of the Extension of the University should be contingent upon the receipt of substantial contributions from Private Sources; and that an account of the Expenditure of any Annual Grant be submitted to the Government, with a view to the exercise of Parliamentary control.

GLASGOW.

The Science Curriculum.

82. There are Four Faculties in this University, and the Students are distinguished into Students of Arts, Theology, Law and Medicine, according to the nature of their principal studies. The position assigned to Science in the Arts Curriculum is governed, as in the other Universities, by the Provisions of Ordinance 14.

83. Since the date when we received Evidence from this University, the Senatus has instituted Degrees in Science with four alternative Courses of Study, viz., Law, Biological Science, Geological Science, and Engineering Science. No Faculty of Science has yet been instituted, but the Faculty of Medicine, and that of Arts are said "to contain "between them in their provinces nearly all of what is commonly called Science."

See Glasgow University Calendar for 1873–74, p. 87.

84. The Degrees in Science were instituted in consequence, as we have been informed by Professor Allen Thomson, of a feeling that Science was too much neglected in the old Arts Degree, and "it was thought best to institute a separate Degree in Science, for "which also facilities existed from the fact of its being recognised in the last Reform "Act for Scotland as a qualification for the University franchise. The Representation "of the People of Scotland Act recognises the Bachelorship of Science as a degree "qualifying to vote. There is no mention of a degree in science in the University Act, "nor in the Report of the Commission of 1858; but the Commissioners took evidence "from the professors and others with respect to the question whether there was reason "to modify the degree in Arts." Professor Thomson suggested "that the topics "included in the Curriculum of Arts were too various and too extensive to enable any "candidate to acquire a sufficiently good knowledge of them to appear for an examination," and "that the Degree in Arts should be modified, somewhat after a plan of "divergence in four directions; that a curriculum of two years, which all should be "required to go through, including, of course, languages and mathematics, should form "a common foundation, and that then the degree might be given to the candidates who "pursued their studies and passed Examinations in four different sections—classics, "literature, and languages for one; philosophy, meaning mental philosophy, for another; "mathematics, physical science, and natural philosophy, for a third; the fourth, which "would probably require subdivision, being natural science or biology and geology." Qu. 9864.

On further consideration it was decided that candidates for the Degree of Master of Arts should be permitted to graduate in any of the four courses of study to which we have referred. The present arrangements have thus been described to us by the same Witness:— Qu. 9865.

"In the Scheme which has been adopted by the Senatus, while the scientific "branches are recognised separately, they are in each department combined with a "part of the arts curriculum. Our degree in law has hitherto been only an honorary "degree, and it was held to be desirable that we should have the means of giving "a degree upon study, and law is accordingly one of the departments. A certificate "in engineering had already been given, and it was considered desirable to raise that "into the rank of a degree; that is the second department, viz., of engineering and "mechanics; the third department is that of natural science, divided into two, the "biological and the geological sections. In each of these three departments the "branches of study which were considered most immediately necessary and specially "connected with the department are made to constitute the curriculum; and then, "in somewhat different proportions, the residuum is made up of a varying number of "branches taken from the curriculum of arts at the choice of the candidates." Qu. 9867.

85. We extract from the Calendar of the University, for 1873–74, the following account of the Subjects required for Graduation in each of the Departments in Science:—

Glasgow University Calendar for 1873–74, pp. 87, 88.

IN LAW:—1. Scots Law. 2. Conveyancing. And any five of the Classes in the Arts Curriculum: provided always that in the event of a Student taking either Civil Law or Forensic Medicine, or, in conjunction with any University course, consisting of not less than 25 lectures, Political Economy or History, he shall be allowed to dispense with one of the Arts Classes.

IN BIOLOGICAL SCIENCE—Any four of these five:—1. Chemistry. 2. Anatomy. 3. Physiology. 4. Zoology (including Comparative Anatomy). 5. Botany. And any four of the Classes in the Arts Curriculum.

IN GEOLOGICAL SCIENCE:—1. Geology. 2. Chemistry. 3. Zoology (including Comparative Anatomy). 4. Higher Natural Philosophy. And any four of the Classes in the Arts Curriculum: provided always that in the event of a Student taking Geodesy in conjunction with any University Class of not less than 25 lectures, he shall be allowed to dispense with one of the Arts Classes.

IN ENGINEERING SCIENCE:—1. Mathematics (1 or 2). 2. Natural Philosophy (1 or 2). 3. Inorganic Chemistry (1). 4. Geology (1). 5. Civil Engineering (2). And any two of the Classes in the Arts Curriculum except Mathematics and Natural Philosophy: provided always that in the event of a Student taking Geodesy in conjunction with any University Class of not less than 25 lectures, he shall be allowed to dispense with one of the Arts Classes.

86. This classification is open to the apparent objection that the Student is expected to show, upon the occasion of a final examination for his Degree in Science, proficiency in a more or less numerous group of subjects unconnected with that which he has specially selected.

87. We have assumed throughout this and other Reports that there are certain kinds of knowledge and certain forms of intellectual discipline which constitute the essential elements of general Culture, and fall under the two heads of Literature and Science. We have further assumed that means should be taken to ensure the possession of this general culture by all persons who receive an University education, and that it is desirable to permit the Student who has given evidence of this general culture to devote his attention exclusively either to Literature or to Science, and to obtain his Degree by passing an Examination conducted in such a manner as to test the reality and extent of his acquaintance with the subject to which he has devoted himself.

Glasgow University Calendar for 1874-75, p. 78.

88. We learn that in the University of Glasgow the Student who has attended the Lectures on any subjects for the requisite number of Sessions is permitted to present himself for examination in those subjects at the next examination for degrees, and is not again examined in the same subjects as a condition of his taking the Degree of Master of Arts. The regulation under which this privilege is accorded does not, however, ensure freedom from distraction, during the later part of his University Course, to the Student who desires to devote himself more particularly to some one branch of Study, inasmuch as there is nothing to prevent him from postponing, until the end, his preparation for passing an examination in those subjects in which he is content with showing a competent knowledge. Nor does it seem to contemplate, as the normal practice of the larger number of the Students, that bifurcation of which we have maintained the importance, and which we have already suggested in the 33rd paragraph of this Report. The documents printed in the Appendix show that the Regulations for granting Degrees in Science are now under revision; and we, therefore, take occasion to invite the attention of the University Authorities to the above observations.

App. IV., p. 67.

Financial Statement.

Minutes of Evidence, Vol. II., App.V., p. 7.

89. We have received from the Clerk of the Senate the following Statement of Sums applied to the Advancement of Science or to Scientific Instruction in the University of Glasgow, which are derived from Endowments or from Parliamentary Grants:—

I. *Endowments of Chairs.*

	From (1) *University* Revenues.			and (2) *Parliamentary* Grants.		
Natural Philosophy	£267	4	5⅓	£21	0	0
Shuna Rents	20	0	0	—		
Assistants and Class Expenses	100	0	0	100	0	0
	£387	4	5⅓	£121	0	0
Mathematics	230	0	0	62	0	0
Shuna Rents	20	0	0	—		
Assistant	—			100	0	0
	£250	0	0	£162	0	0
Astronomy	£220	0	0	£50	0	0
Assistant	100	0	0	—		
Wilson Astronomical Fund for Instruments, &c.	45	0	0	—		
	£365	0	0	£50	0	0
Civil Engineering	—			£275	0	0
Natural History	—			200	0	0
Chemistry	—			200	0	0
Assistants and Class Expenses	£70	0	0	200	0	0
Botany	—			200	0	0
Shuna Rents	20	0	0	—		

II. *Bursaries, Prizes, &c.*

Watt Prize of 10*l.* annually for an Essay on a Scientific subject.
Walker Prizes in Civil Engineering and Mechanics; annual value, 15*l.*
Cleland Gold Medal (10*l.* 10*s.*), awarded every second year to a Student of Natural Philosophy.
Breadalbane Scholarships (two, each of 50*l.* annual value) in Mathematical and Natural Science.
Sir William Thomson Experimental Scholarships (three, each of 20*l.* annual value).
Neil Arnott Prizes in Natural Philosophy, consisting of the free annual value proceeds of Dr. N. Arnott's gift to the University of 1,000*l.*

90. A Statement of the total Emoluments of the Professors, inclusive of Fees, will be found in the Appendix. It will be observed that there is a great disparity in the amounts received. Appendix IV., pp. 68, 69.

91. In addition to the Annual Grants, a statement of which has been given, very considerable assistance was afforded by the Government to the University at the time of its removal to the site which it now occupies. When this transfer was made, a sum of nearly 100,000*l.* was contributed locally, chiefly in the city of Glasgow. The sale of the Old College and ground produced 100,000*l.* A further sum of 17,500*l.* represented the principal and interest of the compensation obtained by the University from the Monkland Junction Railway Company for the non-fulfilment of their agreement. In consideration of the importance of the work, and the public interest excited by it, the Government of the day announced their intention to ask Parliament for the sum of 120,000*l.* in six annual instalments, on condition of a like amount being raised by subscription and expended on the buildings. This proposal was assented to by Parliament, and the sixth instalment of 20,000*l.* was paid in 1873–74, the public subscription towards the combined extension, including the erection of a hospital, having then reached the large sum of 171,642*l.* Glasgow University Calendar, 1873–74, pp. 16–18.

Number of Students; Fees; and Bursaries.

92. The number of the Matriculated Students attending the University Course in the past Session was 1,456,—distributed in the following manner between the different Faculties:— App. IV., p. 70.

Faculty of Arts - - -	904
Faculty of Medicine - - -	339
Faculty of Law - - -	153
Faculty of Divinity - - -	60
Total -	1,456

93. Each Student attending the University pays annually a Matriculation fee of 1*l.*, and also a Class fee to each Professor whose lectures he attends, the fee for each Course being 3*l.* 3*s.*, with the following exceptions, viz., Natural Philosophy, Scots Law, Civil Law, Conveyancing, 4*l.* 4*s.* each; Astronomy, 1*l.* 1*s.*; Political Economy, 1*l.* 11*s.* 6*d.*; and higher Metaphysics, 1*l.* 11*s.* 6*d.* App. IV., p. 70.

94. It appears from the Calendar that Bursaries, varying in value from 4*l.* to 50*l.* a year, are attached to this University. Of these eight only are, we observe, specially available as rewards for Proficiency in Science. A large majority of these prizes are restricted to inhabitants of particular localities, members of particular families, or they are otherwise strictly limited.

The Engineering School.

95. The situation of the University of Glasgow, in one of the Industrial Centres of this Empire, and in the midst of a densely-inhabited district, upon the face and under the surface of which manufacturing and mining enterprise are widely spread, has tended to increase the attention paid in its course of Instruction to branches of Science admitting of Application to Commerce and Manufactures. It has, accordingly, become the seat of an important Engineering School. The Chair of Civil Engineering and Mechanics itself was instituted in 1840, and is endowed by a Parliamentary Grant. The present Department of Engineering Science was not, however, established until about 12 years ago. The functions of this Department are not limited to the preparation of Students for the Degree in Engineering Science. It was described to us by the late Professor Rankine as "consisting of a course of study in the various "branches of Science that are applicable to Engineering, and followed by a System of "Examinations, and the granting of what we call a Certificate of Proficiency." Professsor Rankine continues: Qu. 9506.

"We had a reason for giving it that title of Engineering Science; because we do not profess to teach pure practice, but the art of applying scientific principles to practice; and we did not want our certificate to pass as a certificate that the holder of it was fit to practise the profession, but only as a certificate that he possessed the requisite scientific knowledge. As to the details of the course of study, there is, in the first place, Mathematics, which the student studies for one or two years, according to what his previous preparation seems to render necessary. If he has not passed through a preliminary examination, he has to study Mathematics for two years at least. There is a preliminary examination, by the passing of which the minimum time which he has to devote to Mathematics is reduced to one year. When I say a year, I mean the University session for one year. Secondly, in Natural Philosophy or Physics, if he studies for the minimum period of one session, it may be increased to two, according to the proficiency which he shows. Thirdly, as to Inorganic Chemistry, he studies until he has attained a knowledge of the fundamental principles of Chemistry; of the Chemistry of the more ordinary metals used in engineering structures and machines, such as iron, zinc, tin, copper, and so on; of the chemistry of building materials, such, for example, as cementing materials and building stones; and of the chemistry of air and water, and such elementary matters as that. The fourth subject is Geology, and in Geology his studies are specially directed to what the writers of the present day call Lithology, a branch of Geology that relates to stone and the substances that are used as building materials; he also studies Petrology and Stratigraphy, which have a bearing upon the execution of earthwork. Those are the parts of Geology which are more especially applicable to engineering. Then the fifth branch of this department of study, which concludes the list of the compulsory branches, is civil engineering and mechanics, which is studied for two sessions. This branch relates to the art of applying the principles of the other branches of Science mentioned to practical purposes. There is a special mode of treating such principles where they are to be applied practically; for instance, to engineering field work, to engineering structures, and to machines; a special method different from a purely scientific treatment. I will mention one of the special characters of the application of scientific principles to practice. For any given practical purpose there is a certain degree of precision required inferior to the precision required for purely scientific purposes; and the student ought to be able to judge of the degree of precision that is wanted in applying Science to a particular practical purpose, in order that time and labour and expense may not be wasted on an unnecessary degree of precision. It is a very important and rather difficult subject, and I could exemplify it at great length, but I suppose it is not necessary to occupy the time of the Commission by giving detailed examples of it. Then, on passing a satisfactory examination in those five branches, a student receives a Certificate of Proficiency in Engineering Science."

96. Before the Certificate referred to in the foregoing Evidence can be obtained, the Student must show a proficiency in Mathematics and Natural Philosophy sufficient to qualify him for Second Class Honours in Arts. No Literary Subjects are, however, required for the Certificate, which denotes merely "Proficiency in Engineering Science," but not that the Student is qualified to execute or superintend works. Should he desire to obtain not only this Certificate but also a Degree, he must study any two additional subjects taken from the Curriculum of Arts, and of those two, one must be Literary or Philosophical. The Degree may be with or without Honours; the subjects prescribed for Graduation will be found in the Table extracted from the University Calendar, already given in para. 84. There is no Compulsory Entrance Examination in this Department; there is, however, a Voluntary Examination, by passing which a Student may, if he means to take the Arts Degree, shorten the duration of his attendance by about a year.

97. Professor Rankine stated that his pupils usually came to him fairly prepared in Mathematics. Preparatory study is, he considered, scarcely wanted in the remaining subjects, with the exception of Drawing, for the teaching of which there is no provision in the University. "There is evidently," the Professor remarked, "a deficiency of "good instruction in Drawing throughout the country generally." Qu. 9507.

The same Witness has given us important Evidence with regard to the Association of Scientific Teaching with the Applications of Science:

Qu. 9509. "The main point which has been impressed upon me by my experience is the advisability of carrying on scientific study and practical study as completely separate and independent departments. When I first became professor the lectures were attended to a considerable extent, and to some extent they are attended now, by young men who are actually engaged in business at the time, and who are working at some practical business as civil engineers or as mechanical engineers during one part of the day, and get leave of absence, or find leisure, somehow or another, to attend the lectures also. From my experience that does not answer. It is too great a strain for one thing upon the mental faculties; and then the states of mind required in practical operations and in scientific study are so different that a sudden change from the one state of mind to the other at different periods of the day is injurious to both. In the earliest years of my holding this professorship, I was induced to give evening lectures. In fact, my predecessor lectured in the evening, and I followed the same plan, in order that not only young civil engineers' assistants, but young men engaged in mechanical engineering works and in workshops might be able to attend, but I found those evening lectures were all but useless. The students were very attentive, but when I came to examine them I found that the instruction given to them had taken little hold upon their minds. I found, in fact, that from the state of bodily and mental fatigue in which they were, there was little or no permanent benefit gained."

Qu. 9511. 98. Professor Rankine's experience led him to think that lectures given in the evening, or during the intervals between working hours, will not be practically useful to the students, and "that the best way to combine practical and scientific instruction is what "we actually practise, indeed, to a great extent, or induce our students to practise as "far as we can, that is, to devote the winter half of the year to scientific study, and "the summer half to practical work." The following further definition of the limits within which Applied Science may be taught within an University was given us by the same Witness:

Qu. 9511. "I think it useless to attempt to give instruction in practice proper in an University. If, for instance, we set up a mechanical workshop with machine tools in it in our University, or if we got, say a mile or two of railway, and set our students to superintend the works, this would be worse than useless. The difference between doing things on a small scale like that, and doing things on a great scale, as in actual practice, is so great that the students would only be led to fancy that they had more knowledge than they really did possess, and, therefore, I am for having the practical knowledge acquired at separate times and places by practice on a great scale. There is one rather apparent than real exception to that. I think that a certain degree of instruction in mechanical manipulation would be useful in our University, or in any University indeed, but rather in connexion with experimental physics than with engineering: such instruction as would make a student, if he were engaged in scientific inquiry, able to make his own apparatus. That actually goes on in the University of Glasgow in the physical laboratory. A great deal of the apparatus used there is made by the students themselves, under the superintendence of the professor and his assistants. This would be useful to young engineers as well as to other students; but they should not be led to suppose that in practising mechanical manipulation on that scale they are at all qualifying themselves for the practice on the great scale that one meets with in engineering workshops, or in the execution of lines of railway or other engineering works."

"The proper functions [of an University] are, first, to teach those branches of science proper that are applicable to engineering and mechanics, and, secondly, to teach the special art of applying scientific principles to practical purposes. * * * The University having given the student this instruction, and having examined him to see that he is properly proficient in it, can then certify that he is a proficient in engineering science, but not that he is one qualified to execute or to superintend works. I think there is a limit to the function of an University, which is to impart and to certify the scientific knowledge, but not to certify the practical skill, of the candidate." Qu. 9512.

99. Engineering has now become a profession comparable in importance with reference to the wants of the present time to Law and Medicine. In the University of Glasgow, as well as in some other Universities, there is a tendency to claim for it recognition as a Faculty. When this claim is conceded, this new Faculty, with that of Medicine, will stand in the same relation to the Faculty of Science as that in which the Faculties of Theology and Law at present stand to that of Arts; and just as we should maintain that a Degree in Medicine ought to be preceded by an Examination in Science, and Degrees in Law or Theology by a General Examination in Arts, so, also, we should be of opinion that Candidates for a Degree in Engineering should be required to pass a Preliminary Examination of a general kind in Science.

100. The Certificates to which we have above referred are awarded to Candidates showing Proficiency in Engineering, unaccompanied by any evidence of General Culture, either Literary or Scientific; but the distinction between the "Certificate" and Degree is, we consider, sufficiently marked to justify the dispensation with such evidence in the case of the Certificate. We are, moreover, of opinion that by granting such Certificates to Students who may be unable to follow the complete course of study prescribed for Graduates, the University has been able to extend its benefits to a large class which might otherwise be excluded from them, and which, living as it does in the immediate neighbourhood of the University, should certainly be as far as possible brought into contact with its influences.

Museums, &c.

101. The University is fortunate in the possession of a good Museum, called the Hunterian Museum. This Museum contains a general collection bequeathed to the University in 1783 by Doctor Wm. Hunter, together with 8,000*l*. for the erection of a building and the maintenance of the collection. The collection has been accommodated in the New University Buildings; it contains an important Anatomical Department, besides a Library of rare books and manuscripts, coins, and antiquities, pictures, and natural history specimens. The Museum is available for teaching purposes and maintained by the University at a cost of about 300*l*. per annum, the whole of the original bequest having been expended. The University has also an Observatory with a considerable collection of instruments. The Professor of Anatomy has a collection of his own and another purchased by the University, the two together forming a large Illustrative Class Museum. Some of the other Professors possess small Class Collections. There are a Botanic Garden and Collections in the city of Glasgow to which the University has access.

102. We learn, however, that there is a total want of funds for the maintenance of the Museums, both public and private, and that the expense of supporting the private Museums has fallen entirely on the Professors.

The Chair of Natural History.

103. Our attention has been called to the position of the Chair of Natural History, the occupier of which has represented to us "that, as the Chair is at present arranged, it is "perfectly impossible for the holder of that Chair to do justice to the work that is "expected of him; that in the first place he is required to teach Zoology to Medical "Students; in the second place he is required to teach Geology to Students of Engineering; that those two offices are incompatible, since to discharge the one adequately "he would require to spend his whole year in dissections and indoor study; and to do "the work of the other, he would require to be the major part of the year in the field, "making investigations in geology, and that the combination of the two duties renders Qu. 9571.

" it imperative upon the teacher to neglect, to some considerable extent, one or the " other. In my own case," says Professor Young, I have been obliged to surrender " the Geological Section of my work to some extent, so as to attend more thoroughly to " the Medical Students, the requirements of the General Medical Council making it " imperative upon me that I should do my best for the very large number of Medical " Students who attend my class."
This Chair receives 200*l.* altogether from a Parliamentary Grant, and the fees amount to about 260*l.* Sir Wm. Thomson expresses his opinion that it is, perhaps, the most Qu. 2741. insufficiently endowed of all the Professorships in the University. There is a complete concurrence of testimony with regard to the objectionable character of the arrangement under which this Professor has charge of the two subjects of Zoology and Geology, and as to the inadequacy of this Endowment. Dr. Allen Thomson, the Professor of Anatomy, Qu. 9797. is of opinion that there would be great advantage in separating the two subjects and assigning them to distinct Chairs.

104. In this opinion we entirely concur; and we Recommend that provision be made out of moneys voted by Parliament for the Endowment of an additional Chair between which and that to which we have just referred the subjects now dealt with by Professor Young should be divided in the manner most advantageous to the University.

Deficiencies as regards Assistants.

105. In this University, as in that of Edinburgh, the want of sufficient and competent assistance to the Professors forms an obstacle in the way of the efficient Teaching and Study of Science. It appears from the table quoted on p. 16 that no provision is made either from Parliamentary Grants or from University Revenues for the payment of Assistants to the Professors of Civil Engineering, Natural History, or Botany.

106. The Natural History Professor states that—

Qu. 9576. "But for the accident that I am Keeper of the Museum, I should be absolutely without assistance. There is an Assistant Keeper of the Museum, who receives a salary of 100*l.* a year from the University; and in my own interest I pay him 25*l.* a year out of my own pocket to secure his co-operation in the Geological Course. Other assistance I have none as regards the Chair. What assistance I have, therefore, comes entirely out of my own pocket, and no provision in the Universities' Act admits of my receiving such assistance, because the terms of the Act go to forbid an increase of the emoluments of any Professor."

Qu. 9601. The same Professor complains that in his own department he suffers "from the want " of some one who would undertake especially the Histological Course, requiring a great " deal of time to be expended upon the preparation of the specimens, and upon the " instruction of the students in the method of preparing those specimens. In Geology " I am practically at a standstill, as regards the special training of Engineering Students, " from want of some one who could undertake a sufficiently good course of instruction " in Mining. For three years, at my own expense, I procured the assistance of a " medical student who had come to the profession from the pit, who gave a course " each year of 10 or 12 lectures upon Practical Mining. I paid him, and I supplied " him with the necessary plant and all the expenses required for taking the party out " to the field for practical instruction."

107. The Professor of Engineering makes the following statement:—

Qu. 9513. "In connexion with the teaching of the scientific principles of Naval Architecture, which I have mentioned as one of the subjects of my lectures, there should be an assistant, a lecturer, or a teacher of some kind, to teach a variety of details that are not properly the subject of lectures, but such details as are taught in the Royal School of Naval Architecture, namely, the preparation of the plans of a ship and the making of a set of routine calculations which in designing a ship are always required. This, in fact, can only be done by the help of some assistant or teacher for that purpose."

Qu. 2680. 108. Sir William Thomson observes, "that it is absolutely necessary, for the efficiency " of the teaching and for the position of the Professors in respect to the Advancement of " Science, that there should be a sufficient number of assistants of the Tutorial Class."

109. The Professor of Anatomy states that, in conducting his practical or laboratory Qu. 9825. work, he has the aid of a Demonstrator and several Assistants, and that such employment is much desired by young men of merit.

110. The Professor of Chemistry has two Assistants under the Ordinances of the Commissioners; these are both Skilled Assistants and receive 100*l.* a year each from a Parliamentary vote.

Conclusion and Recommendation.

111. Upon a review of this Evidence we are of opinion that an increase in the payments on account of Assistants to the Scientific Professors is essential to the promotion of the Teaching of Science in this University; and we recommend that the Government Grant

be augmented sufficiently to permit the University to make this increase, and to revise the Salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees; an account of the expenditure of this Annual Grant being submitted to the Government with a view to the exercise of Parliamentary control.

THE ANDERSONIAN INSTITUTION.

112. Before leaving the subject of Scientific Instruction in Glasgow, we desire to refer briefly to the Evidence we have received as to an Institution in that City known as "Anderson's University." This Institution was founded under the will of John Anderson, Professor of Natural Philosophy in the University of Glasgow, towards the close of the last century, with the object of affording a higher education to the working classes of Glasgow. It is governed by eighty-one Trustees, and by nine Managers elected by the Trustees. In the will of its Founder, it is designated an University, and has Departments which are termed Faculties of Arts, Medicine, Law, and Theology, but as it has neither a Charter nor the power of granting Degrees, it is not an University, nor has it Faculties, in the usual sense of those terms. The Faculty of Arts includes Physics, Mathematics, and Chemistry. The Faculties of Law and Theology are both in abeyance.

It is stated in the Evidence that, "with the exception of philosophical apparatus " and personal effects, there was little else than the formation of the system mentioned in " the will wherewith to carry out the intentions of the Founder."

Qu. 9943.

The Institution, of which the system was indicated in the will, has, we are told, " been maintained, up to the present day, in its present efficient condition, through the " perseverance of the Trustees and the occasional gifts from time to time of the citizens " of Glasgow." The Trustees have also, it would seem, at different times, made purchases of property which has been mortgaged to banks, the Institution paying the interest of the loan. More recently the Institution has received liberal gifts of 10,500*l.* from Mr. Young "for the purpose of establishing a Chair of Technical Chemistry"; of 2,100*l.* from Mr. Euing for building purposes; and of 5,000*l.* from Mr. Freeland for the extinction of debt. No endowments have, however, been attached to any of the Faculties, and the Lecturers are dependant upon fees. Until lately they were obliged to pay rent for lecture-rooms.

Qu. 9944.

Qu. 9985, and 9987.

113. The attendance on the Scientific Classes appears to be fairly numerous. In addition to these, Popular Classes have, from the first, been carried on in the evening, and the attendance at these appears to be increasing. 7,500*l.* has been assigned by Mr. Freeland, and 3,000*l.* by Mr. Euing of Glasgow, in support of these classes. The number of the Students attending the Institution in 1873–74 is shown by the Calendar to have been 2,499.

Qu. 9969.

Calendar for 1874–75, pp. 31, 32.

114. The fees payable are as follows:

Faculty of Arts:—

Chemistry (lectures and demonstrations), 2*l.* 2*s.* per course of six months.

Technical Chemistry, 18*l.* per session of nine months, 7*l.* for three months, or 2*l.* 10*s.* for one month.

Ibid., pp. 19, 20.

Faculty of Medicine:—

Class fees for each course of lectures: First session 2*l.* 2*s.*, second session 1*l.* 1*s.*, afterwards free.

Anatomy class fees, for both courses (lectures and demonstrations): First session 4*l.* 4*s.*; second series 4*l.* 4*s.*; summer session, with dissection, &c., 1*l.* 1*s.*

Practical Anatomy: the Dissecting room is free for two Sessions to those who attend both courses of Anatomy; after the second year, the fee for Practical Anatomy is 1*l.* 1*s.* per Session.

Ophthalmic Surgery: Attendance gratis by paying a Matriculation Fee of 5*s.*

The fees for all the Lectures and Hospital Practice required of Candidates for the Diplomas of Physician and Surgeon amount to 50*l.*

The fee for attendance at the Evening Classes is 2*s.* 6*d.* or 3*s.*, except in the case of one Course, that of Applied Mechanics, in which a fee of 10*s.* 6*d.* is charged; the payment of these fees entitles the Student to admission to a library of 6,000 volumes.

Qu. 9980.

115. There does not appear to be any regular System of Examinations in connexion with the Evening Classes; the Students can, however, present themselves at the Examina-

tions of the Science and Art Department. We have received from Mr. McClelland, Qu. 9975. one of the Trustees of the Institution, a table showing the occupations of over a thousand of the Students by whom these Evening Lectures are attended. This table proves that the working classes of Glasgow are in the habit of availing themselves Qu. 9989. extensively of them; the order of students, on the other hand, who attend the Faculties of Medicine and of Arts, is pretty much the same as that by which the Glasgow University is attended. We observe that Students attending these Classes are drawn from all parts of the United Kingdom.

116. It has been suggested to us that this Institution might, under certain circumstances, receive a Charter, in order to enable it to compete, on more equal terms, with the University of Glasgow. In this suggestion we are not able to concur; the proper function of the Institution is, we believe, to afford facilities for education to those classes whose means or opportunities do not permit them to follow an University course. The competition for students of the same class to which we have already referred is, perhaps, inevitable, but should not, at all events, be encouraged; nor do we believe that an increase in the number of Degree Giving Bodies in Scotland is desirable in the interests of the Higher Education of that Country.

It has also been suggested to us that the Institution might be used as a Central Establishment for the Training of Scientific Teachers, and that it might receive a Government Endowment for this purpose.

St. ANDREW'S.

The Colleges and Scientific Chairs.

117. This University contains two Colleges, the United College of St. Salvator and St. Leonard, and St. Mary's College.

118. The Scientific Department of the University consists of five Chairs, comprising Mathematics, Natural Philosophy, Chemistry, a Chair of Civil History and Natural History, and of Medicine and Anatomy. A certain degree of acquaintance with the subjects taught by the Professors occupying the first three of these Chairs is required of all Students Graduating in Arts. The Theological Students are required to attend the lectures of the Mathematical and Natural Philosophy Professors.

Qu. 9618 119. The Professor of Mathematics "teaches in the junior class six books of Euclid, "Algebra as far as Simple Equations, including ratio and proportion, and the Theory of "Arithmetic. In the second class Algebra, Plane Trigonometry, the application of "Algebra to Geometry, Trigonometry, and Conic Sections. In the third, or senior "class, for three days a week he teaches Analytical Trigonometry, Analytical Conic "Sections, and Differential and Integral Calculus."

Qu. 9623. 120. The Professor of Natural Philosophy "teaches one class, lecturing seven hours "a week. His subjects are the Properties of Matter and of Force, including Inertia, "Gravitation, Molecular Forces, Laws of Motion, Conservation of Energy, &c., "Dynamics or Mechanics, including Hydrostatics and Pneumatics, Sound, Heat, Light, "Electricity, Astronomy, and Meteorology."

Qu. 9625. 121. The Professor of Chemistry "teaches one class, lecturing an hour each of the "teaching days, that is five days a week, and he has a practical class, lecturing three "additional hours. The subjects taught are Chemical Physics, including the Chemical "Relations of Cohesion, Adhesion, Heat, Light, and Electricity; Chemical Philosophy, "including the Atomic Theory; the Non-Metallic and Metallic Elements and their "Compounds, and Organic Chemistry."

122. Of the Chair of Civil and Natural History, which is in private patronage, we have received the following account from the Principal of the University :—

Qu. 9629. "It was originally the Chair of History, which was interpreted to mean Civil History. The University Commissioners gave it the name of the Chair of Civil and Natural History. The Chair does not belong to the curriculum, and it has not been practically an useful Chair ever since I recollect, and my recollection extends to the period when I was a Student, as well as since I became officially connected with the University. Dr. Ferrie was the Professor when I was a Student, and he lectured occasionally upon General History. The class was attended for three or four lectures, and then it ceased. Dr. McDonald, the present Professor, has occasionally managed to get a class, but from many causes the class has not been regular."

Qu. 9630. "Then you would say that the University at present gives no instruction in any branch of Natural History? —I cannot say that it does."

This condition of things was, however, described by another Witness as only temporary, and we learn that on the death of Dr. Macdonald, a Naturalist was appointed to this Chair.

123. The Professor of Medicine and Anatomy has a class described to us by the Principal as a semi-popular one; the lecture being chiefly devoted to the hygienic aspects of the subject. No Examination is held in this Class, which generally numbers about 30 and is chiefly attended by the Senior Students. Qu. 9636.

Museum and Library.

124. The University Museum is represented to us as fairly good; the collection is mainly a local one, but it is pretty complete in all the Departments of Natural History, and as a Teaching Museum it is in excellent condition.

The University Library is a very extensive one, consisting of about 110,000 volumes; but the buildings in which it is placed do not afford proper accommodation for the books. These buildings, like most of those in the Scottish Universities, are the property of the Nation, and the expediency of a grant for their extension has, we are informed, been under the consideration of different Governments during recent years.

Financial Statement.

125. The Capital Fund of the University is about 21,000*l.*, and its annual income consists of the interest on this sum, and the Matriculation and Graduation Fees, amounting to 500*l.* or 600*l.* a year. A sum of 600*l.* a year, received as commutation of the University's right to books from Stationers' Hall, is spent upon the Library. The total expenditure upon this, however, including salaries to librarians, exceeds this amount. The income of the Colleges may be taken at 2,670*l.*, but the appropriation of the whole of the College revenues is determined by Act of Parliament or by Ordinance of the Commissioners, so that there is no surplus revenue from College Funds available for other purposes. We have received from the Senior Principal the following Statement of the only sums which can, in his opinion, be considered as applied from Endowment, or from Votes by Parliament to the Advancement of Science or to Scientific Instruction in the University of St. Andrew's: App. V., p. 70.

EMOLUMENTS of the following CHAIRS in the UNIVERSITY of ST. ANDREW'S (year 1870).

Minutes of Evidence, Vol. II., App. V., pp. 5, 6.

	£	*s.*	*d.*	£	*s.*	*d.*
MATHEMATICS:						
Salary under Act 20 George II., c. 32	—			71	0	0
Estimated share of surplus College revenues	—			129	18	0
Parliamentary vote—						
Present	55	11	0			
*New	53	9	0			
				109	0	0
Estimated fees				200	0	0
				£509	18	0
NATURAL PHILOSOPHY:						
Salary under Act 20 George II., c. 32	—			80	0	0
Estimated share of surplus College revenues	—			129	18	0
Parliamentary vote—						
Present	55	11	0			
*New	94	9	0			
				150	0	0
Estimated fees				85	0	0
				£444	18	0
NATURAL HISTORY:						
Salary under Act 20 George II., c. 32	—			60	0	0
Estimated share of surplus College revenues	—			129	18	0
Parliamentary vote—						
Present	55	11	0			
*New	44	9	0			
				100	0	0
Estimated fees				80	0	0
				£369	18	0

---

* These sums represent the additions to the Emoluments of the Chairs recommended by the Commissioners of 1858.

CHEMISTRY:

	£	s.	d.	£	s.	d.
Income from Dr. Gray's Foundation, estimated by Commissioners at 125*l.*, but does not exceed				90	0	0
*New Parliamentary vote				125	0	0
Estimated fees				80	0	0
				£295	0	0

MEDICINE:

	£	s.	d.	£	s.	d.
Salary under Act 20 George II., c. 32	—			60	0	0
Estimated share of surplus College revenues	—			129	18	0
Parliamentary vote—						
Present	55	11	0			
*New	44	9	0			
				100	0	0
Estimated fees				30	0	0
				£319	18	0

App.V., pp. 70. 71. 126. A similar return for the past year will be found in the Appendix. It will be seen that the emoluments of the Scientific Professors are uniformly low.

Number of Students, and amount of Fees.

App. V. p. 71. 127. The number of Students attending the Classes in the Faculty of Arts during the Session 1874-75 was 118. The number attending the Faculty of Theology was 23, making a total of 141 Students, thus distributed among the Colleges:

Number of Matriculated Students at the United College	118
Number of Matriculated Students at St. Mary's College	23

App. V. p. 71. 128. Students attending the United College pay a Matriculation Fee of 1*l.* on entering, and a fee of 3*l.* 3*s.* for each Class they may attend during the Session. Should they attend three Classes, which is the average number, the annual payment made by each Student amounts to 10*l.* 9*s.* In the event of their proceeding to Graduation in Arts, a further fee of 1*l.* 1*s.* is payable for each of the three Departments of Examination. Students of St. Mary's College pay a Matriculation Fee of 1*l.*, and a Fee of 2*l.* 2*s.* for each of the Classes they attend, which is in general three in number.

Deficiency as regards Assistants and Apparatus.

129. The Scientific Instruction given in the University of St. Andrew's suffers equally with that given in the other Scottish Universities from the want of Skilled Assistants.

130. With regard to Laboratories and Apparatus, we have it in Evidence that although the Professors of Chemistry and of Civil and Natural History, and of Medicine and Anatomy, have their respective apparatus, and receive annually from the University a grant for the purpose of adding to and restoring it, the apparatus is very inadequate and the sum allowed insufficient for the purpose for which it is intended. The Principal of the University expresses his conviction that the University requires additional apparatus and appliances for teaching, and states that the University has no funds available for the purpose. Qu. 9643.

131, The Professor of Chemistry receives from the University an annual grant of 52*l.* 10*s.* for all the working expenses, including apparatus, chemicals, and Assistants. It is scarcely matter for surprise that the whole of this sum should not have sufficed to provide the two former items, and that the Professor has in consequence never had any assistance at all except that which one of the Senior Students has, from time to time, been, in his own interests, willing to afford. The Professor has given it as his
Qu. 9780. opinion that, " in present circumstances, an assistant at a salary of not less than 80*l.* is " absolutely necessary; and it would require a sum of from 100*l.* to 120*l.* for the pur- " poses of apparatus and chemicals, and waste of materials," that being the amount of the sum which he has voluntarily made up out of his own pocket, in order to keep the class in efficient working.

132. The Professor of Natural Philosophy receives also 52*l.* 10*s.* for all expenses, and out of this sum 12*l.* only is, he informs us, available for the payment of an assistant. When

---

* These sums represent the additions to the Emoluments of the Chairs recommended by the Commissioners of 1858.

asked, "Do you feel the want of an assistant of a different kind from that which you "are enabled to provide under the present arrangements?" the Professor replied: Qu. 9737.

> "I do very much indeed. Indeed, I am obliged every day that I give an experimental lecture to work for a great many hours, never less than four hours, doing a great deal of work which an assistant ought to do. Then on the other alternate days, by anticipation, I am also obliged to work in preparing experiments, so that a great deal of time is occupied in doing common work, which an assistant might do. Even our present stock of apparatus is valuable, and will, every year, become more so; and in the event of increased grants, we may expect to have a very valuable stock of apparatus in a few years. It is extremely desirable that some Curator of such a collection of apparatus should be provided, able to take care of it. Such an assistant as I have, at 12*l.* a year, although he is an extremely intelligent and perfectly honest man, has not knowledge enough to be entrusted with such a collection. It would need a man specially educated to take charge of such a collection."

133. The Scottish Universities Commissioners, who, in consequence of the inadequacy of the resources at their command, provided very insufficiently for the appointment of Assistants to the Scientific Staff of the other Universities, did not recommend a grant for this purpose to the University of St. Andrew's, which has accordingly been obliged to fall back upon its own slender resources. Para. 22.

134. It is our opinion that the Teaching of Science should be encouraged in this, as in every other University, as a part of the groundwork of a Complete System of Education, and that the Staff of the University, and the Appliances at its disposal, should be sufficient to secure this end. We are not, however, disposed to suggest any steps which might have the effect of erecting at St. Andrew's Technical or Medical Schools such as those of Glasgow or Edinburgh.

Proposed Connection with Dundee.

135. The University of St. Andrew's is distant 11 or 12 miles in a direct line from the town of Dundee, from which, moreover, it has been hitherto effectually separated by the intervening Frith of Tay. The completion of the bridge now under construction will, however, render the town and the University much more accessible to each other, and it has been suggested that advantage should be taken of their vicinity in order to connect them for purposes of education.

136. We have received Evidence with regard to the expediency of establishing Classes, taught by the University Staff, for artisans in the town of Dundee, and of founding in Dundee a School of Science affiliated to, and in close relations with, the University. A large building known as the Albert Hall, and containing a Public Library, has been designated as suitable for some such purpose. Whatever may be the decision ultimately arrived at, it must be obvious that no such instruction could be given in Dundee by the University Staff, unless that staff were very considerably increased. The Professors have already as much work as they are able to undertake. We have pointed out that they are far from being adequately provided with skilled assistance, and it would, we think, be unreasonable to expect that they should, in addition to their present lectures and practical classes, travel backwards and forwards between St. Andrew's and Dundee in order to lecture to working men in the evening, or to attend to such Students as might be unable or unwilling to make the short journey between the two places.

137. A certain number of the Students are natives of Dundee, and we may expect that the number will increase. Many of these Students would, in the event of effect being given to such a scheme as that which has been indicated to us, probably cease to reside at St. Andrew's, and would lose thereby the opportunities offered them for acquiring the groundwork of a sound general education. It is further to be observed that the Establishment of a separate Science School in Dundee would necessitate, not only an increase in the University Staff, but also additional Laboratories, and of other appliances which could not be provided except at a very large increase of expense; while, as we have already stated, there are no funds at present available for these purposes. Such an arrangement could only be justified on the grounds of its absolute necessity, and of this we are by no means satisfied, taking into consideration, on the one hand, the ease with which a student who is able to devote the greater part of the day to his studies will be able to attend the St. Andrew's Courses, and, on the other hand, the partial and limited character of the Instruction which artizans, or other persons most of whose time is engaged in professional or commercial pursuits are likely to derive from attendance at Evening Classes.

138. We desire, also, to express our disapprobation of the suggestion which has, it would appear, been made to the University, that the Scientific Chairs of St. Andrew's University should be transferred bodily to Dundee, and that a separate Faculty of Science should be created in that town. It seems to us almost needless to insist on the hardship which such an arrangement would involve to those Students who now undergo, while in residence at St. Andrew's, a course of combined Literary and Scientific Instruction, and who might be called upon to attend possibly during the same day classes in each of the two towns. We should object to the Scheme on this ground alone, but we do so still more from our conviction that it is undesirable to decentralise and separate the different Faculties of the same Universities. Such a System tends in the direction of narrow and specialised education, widely different from that general and broadly grounded culture which it is the true province of an University to promote.

139. Since the date at which our Evidence was received, we have been made aware of the existence of a Scheme which has met with considerable encouragement in the town of Dundee, and of which the intention is to found in that town "a College in which might be "acquired the highest attainments in Literature, Science, and Art." Such a College might, it was suggested, be affiliated to the neighbouring University, the connection implying "that the Teaching of the College is recognized by the University as sufficient "to authorize the Students in that College to compete for Degrees conferred by the "University." The cost of giving effect to such a Scheme is estimated by its promoters at a sum of not less than 225,000*l.* We have no Evidence of the probability of a sum of this magnitude being raised by local or other contributions, and we do not, therefore, feel called upon to express any opinion with regard to the merits of the Scheme, of which the outline only has been before us. We cannot, however, believe that an University so ancient and so distinguished as that of St. Andrew's, possessing a complete University Organization, and a Town of the wealth and enterprise of Dundee, are likely to remain long dissociated; or that the citizens of Dundee, in the event of the establishment of easier and more rapid communication with St. Andrew's, will be slow to avail themselves of the advantages afforded by the proximity of the University.

If, in consequence of such an association, the University were required greatly to extend its establishments for the Teaching of Science, we should not hesitate to recommend that local efforts to meet the necessary expenditure should be supported by a further contribution from Public Funds.

Conclusion and Recommendations.

140. The University of St. Andrew's enjoys an admirable situation, and it is supported by the traditions and associations of a long and interesting history; it needs, we believe, in order to the full development of its usefulness for the purposes of Scientific Instruction, only such assistance as will enable the Professors to give efficiently that education which, with the limited means at their disposal, they are now endeavouring to provide.

141. We Recommend that such assistance should be afforded by an increase of the Government Grant sufficient to enable the University to provide the Professors with an adequate Staff and with the proper appliances for Instruction in Science, and to revise the salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees; an account of the Expenditure of the Annual Grant being submitted to the Government, with a view to the exercise of Parliamentary control.

142. If this be done, we see no reason why the University should not be able, without dismemberment or removal, to enlarge considerably the area to which its benefits extend.

ABERDEEN.

143. It will be observed, on reference to the Correspondence printed in the Appendix to this Report, that the University of Aberdeen has declined to avail itself of the opportunities offered to it of tendering Evidence before this Commission. Appendix VI., p. 72.

144. We have, however, received from the Principal, the following Statement of the sums (derived from Endowments or from Parliamentary Grants) which are available for Scientific Instruction in the University:—

Minutes of Evidence, Vol. II., Appendix V., p. 7.

——	Endowments.			Grants.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.
Professorships, &c.									
Chair of Mathematics (average) - - - - -	124	0	0	76	0	0	200	0	0
Assistant to ditto - - - - -	62	0	0	38	0	0	100	0	0
Chair of Natural Philosophy (average) - - -	186	0	0	114	0	0	300	0	0
Assistant to ditto - - - - -	62	0	0	38	0	0	100	0	0
Chair of Natural History (average) - - -	186	0	0	114	0	0	300	0	0
Chair of Anatomy - - - - -	—			150	0	0	150	0	0
Assistant to ditto - - - - -	—			100	0	0	100	0	0
Chair of Institutes of Medicine or Physiology - -	—			200	0	0	200	0	0
Chair of Chemistry (average) - - - - -	165	10	0	40	8	8	205	18	8
First Assistant to ditto - - - - -	—			100	0	0	100	0	0
Second ditto - - - - - -	—			50	0	0	50	0	0
For class expenses - - - - -	—			100	0	0	100	0	0
Chair of Botany - - - - - -	—			300	0	0	300	0	0
Chair of Materia Medica - - - - -	—			150	0	0	150	0	0
Joint Assistant to ditto, and Chair of Medical Jurisprudence.	—			50	0	0	50	0	0
For class expenses - - - - -	—			50	0	0	50	0	0
	785	10	0	1,670	8	8	2,455	18	8
Scholarships and Prizes.									
Four Scholarships to Graduates for distinction in Mathematics, including Natural Philosophy, each 65*l*. -	260	0	0	—			260	0	0
Neil Arnott Scholarship for most distinguished student in experimental branches of Natural Philosophy.	35	0	0	—			35	0	0
Simpson prize to first most distinguished Graduate in Examination for Honours in Mathematics.	70	0	0	—			70	0	0
Boxill prize to second ditto - - - - -	28	0	0	—			28	0	0
	£1,178	10	0	£1,670	8	8	£2,848	18	8

145. The Arts Curriculum in this University does not appear to differ materially, in so far as the Scientific Subjects which form a part of it are concerned, from that of the other Scottish Universities, with the exception that, under Ordinance 18, it has required all Candidates for Graduation to attend the Lectures of one of the Professors in the Department of Natural Science.

146. No Degree is given in Science, but Candidates for Graduation with Honours in Arts may offer themselves for examination in the Department of Natural Science, which includes, as in the other Universities, Geology, Zoology, Chemistry, and Botany. The Regulations for Graduation appear to us to be judicious, and in accordance with the principles which we have advocated should be adopted elsewhere.

147. The University contains a Medical School, and we learn from the Calendar that there is a Museum of Natural History containing collections of Zoological, Geological, and Mineralogical Specimens, and that there are other Collections used for purposes of illustration in connection with the different Classes of the Medical School. Calendar for 1874–75, p. 24. Calendar for 1874–75, pp. 10, 11.

148. The number of Students attending the University Courses in the University of Aberdeen during the past Session (1874–75) was as follows:— Appendix VI., pp. 72, 73.

Faculty of Arts - - - -		336
Faculty of Divinity - - - -		36
Faculty of Law - - - -		14
Faculty of Medicine - - - -		227
		613
Students in both Arts and Medicine -	8	10
Students in both Divinity and Medicine -	2	
Total number of Students -		603

Appendix, VI., p. 73.

149. The average amount of the fees payable by the Students per annum is as follows :—

	£	s.	d.
Faculty of Arts	7	12	0
Faculty of Divinity	5	13	4
Faculty of Law	5	4	0
Faculty of Medicine	12	0	6

Minutes of Evidence, Vol. II., Appendix V., p. 7.

Minutes of Evidence, Vol. II., Appendix V., p. 7.

150. As in the other Scottish Universities, a large number of bursaries, or scholarships, are annually distributed among the Students. These bursaries are, we are informed, 240 in number, and worth about 4,000*l.* a year. With the exception of those referred to in the above table, we do not learn that any of these are specially available as rewards for Proficiency in Science. We are, however, reminded by Professor Bain, in a letter printed in the Appendix, that " the effect of these bursaries is to educate and assist in maintaining " upwards of 200 young men while pursuing a mixed Curriculum of Literature and the " Sciences, the Literature consisting of the three languages, English, Latin, and Greek ; " the Sciences being Mathematics, Natural Philosophy, Natural History, Logic, and " Moral Philosophy." The bursaries vary in value from about 10*l.* to about 35*l.* a year, and average about 17*l.*, while the cost of education is under 10*l.* a year. We are glad to learn from Professor Bain that—" Nearly two thirds of the bursaries " are given by public competition, the collective annual value of these being about " 2,500*l.*, but the subjects of competition were in former days confined to Classical " Literature. For several years one fourth of the marks has been given for Mathematics, " and by a Scheme, coming into operation next year, Chemistry and Zoology are " admitted into the list of subjects. The obvious tendency of such a competition is to " make the bursaries instrumental in stimulating the study of Science in the Schools " preparatory to the University."

Summary of Recommendations with regard to the Universities of Scotland.

151. In conclusion of our Inquiry into the Universities of Scotland, we beg leave to submit the following Summary of the Recommendations which we have had occasion to make in the course of the above Report :

Paras. 80, 81. With regard to *The University of Edinburgh* we have Recommended :

I. That increased assistance be given, both in the form of a Capital Sum in aid of a well-considered Scheme of Extension, and in that of an Annual Grant sufficient to enable the University—(1) To increase the number, and, in some cases, the emoluments of Assistants ; (2) To make more ample provision of Apparatus for Teaching ; and (3) To revise the Salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees.

II. That the Grant of any Capital Sum in aid of the Extension of the University be contingent upon the receipt of substantial contributions from private sources.

Paras. 104, 111. With regard to *The University of Glasgow*, we have Recommended :

I. That the Chair of Natural History be divided in the manner most advantageous to the University ; and that provision be made out of moneys voted by Parliament for endowing a new Professorship.

II. That the Government Grant be augmented sufficiently to enable the University to make an increase in the Payments on account of Assistants to the Scientific Professors, and to revise the Salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees.

Para. 141. With regard to *The University of St. Andrew's*, we have Recommended :

I. That assistance be afforded by an increase of the Government Grant sufficient to enable the University to provide the Professors with an adequate Staff and with proper Appliances for Instruction in Science ; and to revise the Salaries of the Scientific Professors, regard being had to the disparity of their endowments, and to the income which they derive from fees.

Paras. 81, 111, & 141. We have also Recommended generally :

I. That an account of the Expenditure of any Annual Grant made to the Universities above referred to, be submitted to the Government, with a view to the exercise of Parliamentary control.

Para. 32. II. That for the future two Classes be recognized in the Natural Science Honours List.

III. The University of Dublin and Trinity College.

152. The University of Dublin contains only a single College, Trinity College, which was founded by Queen Elizabeth in 1591, and created a Corporate Body, consisting originally of a Provost, three Fellows, and three Scholars. The Foundation has been enlarged from time to time, and there are now 7 Senior and 26 Junior Fellowships, and 70 Foundation Scholarships.

153. The principal subjects referred to in the Evidence which we have taken with regard to the University of Dublin and Trinity College, are the following:

I. The Courses of Study and the Examinations.
II. The Exhibitions, Scholarships, and Studentships.
III. The Provostship and the Fellowships.
IV. The Professoriate.
V. Museums and other Scientific Institutions.
VI. The Council.

I.—The Courses of Study and the Examinations.

154. For admission into the University, a Student has to pass an Entrance Examination, which includes Classical and other Literary Subjects, together with Arithmetic and the elementary parts of Algebra. At the Entrance Examination there is a further Examination for Honours which is confined to Classical and other Literary Subjects.

155. Sizarships, tenable for four years, may be obtained at Entrance. They are awarded by the result of a Competitive Examination, which, however, is open only to Students of limited means. One Sizarship is awarded annually for proficiency in Mathematics.

156. As regards the mode of obtaining a Bachelor of Arts Degree, the University of Dublin occupies a position intermediate between the older English Universities, on the one hand, and the University of London, on the other. At Dublin, as at Oxford and Cambridge, a certain number of Terms must be kept before the Degree can be obtained, and provision is made for the Instruction and Discipline of Resident Students; but a Non-resident Student is accounted as having kept a Term if he passes an Examination held at the beginning of the following Term. There are thus two distinct ways in which a Term may be kept: (1) by actual residence, combined with attendance at the prescribed Courses of Lectures; (2) by passing the Term Examination.

157. There are three Terms in each year,—the Michaelmas, Hilary, and Trinity Terms,—and the Undergraduate Course extends over four years. It is not, however, essential that the Student should keep all these twelve Terms. He must pass in succession through the four Classes of Junior Freshman, Senior Freshman, Junior Sophister, and Senior Sophister, Classes which are designed to consist of Students of the first, second, third, and fourth years respectively. To pass from Junior to Senior Freshman, the Student must have kept at least one Term *by examination* in his first year. To rise to Junior Sophister, he must have kept at least three Terms in all, of which one at least (which may be kept in either way) must be kept in the Senior Freshman's year, and he must further pass an Examination at the beginning of the third year. The Final Examination for the Degree of Bachelor of Arts is held in the Michaelmas Term of the Senior Sophister year, and before admission to it the Student must have kept one Term by Examination as Junior Sophister, one Term either way as Senior Sophister, and a third Term either way in either year.

158. Thus, a Student, before presenting himself for the Final Examination for the Degree of Bachelor of Arts, must have kept at least six Terms, properly distributed, of which two at least must have been kept by Examination, and he must have passed one Examination besides the Entrance Examination and those by which Terms are kept.

159. The natural operation of these rules would be that Resident Students would, as a rule, keep many more Terms than the minimum required, for the sake of profiting by the Lectures, while Non-Residents would content themselves with passing the Examinations absolutely required, with, perhaps, such additional days of examination as are given to Candidates for Honours. Thus, as regards Residents, although only six Terms, of which two must be kept by Examination, are nominally required in the whole of the four years, the system practically agrees with that which prevails at Oxford and Cambridge; while, as regards Non-Residents, although a larger number of examinations are required to be passed than at the University of London, the position of the University towards the Student is in principle the same, and the University acts merely as an Examining Board.

Qu. 12,738. 160. It is stated by Mr. Jellett, that it is the general opinion at Trinity College that this substitution of attendance on Lectures for a part of the Examinations which would otherwise be required for Degrees works satisfactorily; and that it is generally thought that attendance at a Course of Lectures, which are, in a large degree, catechetical, is a more satisfactory test, and communicates to the Student a greater amount of knowledge than a simple preparation for an examination, no matter how good the examination may be. Qu. 12,739. It is found in practice that Candidates for Honours almost universally attend Courses of Lectures.

Qu. 12,744. 161. The obligatory Subjects of Study in the several years are as follows:—In the first year Mathematics and some Classics; in the second, Logic, a certain amount of Metaphysics, and again Classics; in the third, Mathematical Physics, namely Mechanics and Astronomy, and either Classics or Experimental or Natural Science; in the fourth, Astronomy and Ethics, and two out of the four branches—Classics, Experimental Physics, Mathematical Physics, Natural Science.

162. In the designation of these Courses, it should be observed that the term "Natural Science," being distinguished from "Experimental Science," is used in a restricted sense. The subjects embraced in it are Zoology, Botany, Geology, and (in the case of Moderatorships) Physiology and Comparative Anatomy.

163. A Student is free to devote himself to Science alone from the end of his second year; and as the first year is allowed to be counted by passing an Entrance Examination held near the end of the third Term, and one First-year Examination held at the beginning of the first Term of the following academical year, a Science Student may be free from the obligation to study Classics after little more than a year from entrance; and, supposing he takes his Degree of Bachelor of Arts at the usual time, he has then two years left of his Undergraduate Course which he may devote to the Study of Science.

164. At each Term-Examination, there are Examinations for those Students who are qualified to become Candidates for Honours in the several Departments of Undergraduate Studies in that class. The Honours Courses are as follows:—(1.) Junior Freshmen: Mathematics; Classics. (2.) Senior Freshmen: Mathematics; Classics; Logic. (3.) Junior Sophisters: Mathematical Physics; Classics; Metaphysics; Experimental Science; Natural Science; Modern History; Modern Literature. (4.) Senior Sophisters: Mathematical Physics; Classics; Ethics; Experimental Science; Natural Science; History and Political Science; Modern Literature.

165. At the Examination for the Bachelor of Arts Degree, which is held in the Michaelmas Term of the fourth year, examinations are held for Special Honours called Moderatorships. There are seven Courses in which Moderatorships may be obtained; namely, 1, Mathematics and Mathematical Physics; 2, Classics; 3, Mental and Moral Philosophy; 4, Experimental Science; 5, Natural Science; 6, History and Political Science; 7, Modern Literature. In each subject the Moderators are arranged in two Divisions, Senior and Junior, according to merit.

166. There are four Professional Schools recognized by the University; namely, Divinity, Law, Medicine and Surgery, and Engineering. Degrees are granted in those several Faculties, but only after the Preliminary Degree of Bachelor of Arts has been obtained. Professional Students follow the usual Arts Course for the first two years, after which they are at liberty to commence their Professional Studies. If they do so, they are excused a portion of the Arts Course, for which they may substitute more strictly Professional Studies. The Professional Studies occupy two years at the least.

The Exhibitions, Scholarships, and Studentships.

167. It has been already mentioned that Sizarships are obtainable at Entrance. These, however, being designed to assist the poorer class of Students, and being restricted to those whose parents or guardians are of limited means, do not fall under the head of emoluments awarded purely according to merit.

168. In 1870 it was resolved by the Board that 20 Exhibitions, of the value of 25*l.* a year each, and tenable for two years, should be awarded annually, provided sufficient merit were shown by the Candidates. Of these Exhibitions 12, which are called Junior Exhibitions, are offered for competition to Students of the first year, and the remaining 8, which are called Senior Exhibitions, are obtainable at the close of the second year.

169. The Junior Exhibitions are awarded according to the result of an Examination held in Classics and other Literary Subjects, and in Mathematics as far as Elementary Trigonometry.

170. The Senior Exhibitions are awarded according to the marks obtained partly in a Special Examination in subjects similar to the above, and in Logic and Locke; partly in the Prize Examinations in Mathematics, Classics, Logics, and English Literature and Composition.

171. There are 70 Foundation Scholarships, tenable from the time of election till the holder is of M.A. standing. The Scholars are of two classes, elected for Scientific and for Classical Merit respectively. Candidates for Science Scholarships are examined in Pure and Applied Mathematics, together with a certain amount of Logic and Metaphysics. The value attached to the several branches in the Examination is expressed by the following numbers: Pure Mathematics, 250; Applied Mathematics, 250; Logic and Metaphysics, 100. Candidates for these Scholarships are at liberty to substitute the course in Experimental Physics of the Junior Sophister year for the course in Logic.

172. There are also seven Scholarships, of Private Foundation, for subjects not connected with Science, and 30 Scholarships founded by the Commissioners of Education in Ireland for Students from the Royal Schools of Armagh, Dungannon, Enniskillen, or Cavan. These latter are awarded for general proficiency in a course comprising Classics, English Language and Literature, Modern Languages, and Science. The number of marks assigned to Scientific Subjects is 100 out of 450. The principal Scientific Subject is Pure Mathematics as far as Plane Trigonometry. The Examition includes, however, Physical, as well as Descriptive Geography.

173. By a Royal Statute of 22 Victoria, 14 Studentships were founded in Trinity College open to candidates of all religious denominations, to be tenable for a period not exceeding seven years, with a salary to be fixed by the Provost and Senior Fellows, not exceeding 100*l.* a year. Two Students are elected every year according to the results of the Moderatorship Examinations. The award is decided by the aggregate merit in two Courses, one Primary and one Secondary, which bear credit as 3 to 2. The Primary Course must be one of the two—Mathematics and Physics, or Classics. The Secondary Course may be either the remaining one of those two, or any other of the Moderatorship Courses.

THE PROVOSTSHIP AND THE FELLOWSHIPS.

174. The Provost, who is the Resident Head of the College, is appointed by the Crown. Besides presiding over the whole College, he is, in common with the Senior Fellows, responsible for the Examinations which devolve on the Board.

175. There are 33 Fellowships, which are tenable for life, irrespective of the restriction of celibacy, and are now open to all without distinction of creed. These are divided into 7 Senior and 26 Junior. The Senior Fellowships are filled by co-optation from the Junior; the Junior by an annual election in case there be a vacancy. The average number of vacancies has latterly been hardly more than one per annum.

176. The Fellowships are awarded in accordance with the results of a Special Examination extending over a wide range of subjects comprised in four principal courses, the relative importance of which is approximately determined by numbers representing the maximum obtainable by the highest possible answering in the several courses. These numbers are as follows:—

Mathematics, Pure and Applied - - - - - -		1,000
Experimental Science - - - - - - -		300
Classics - - - - - - - -	800	900
Hebrew and Cognate Languages - - -	100	
Mental and Moral Science - - - - - -		500

177. It will be seen that Classics and Mathematics rank considerably above any other course. Mr. Jellett says in his evidence, "If a student's object is to obtain a Fellow- Qu. 12,750.
"ship, he must, practically speaking, be either a good mathematician or a good classical "scholar. I think that a man who is neither a good mathematician nor a good classical "scholar would have a very slight chance indeed of obtaining a Fellowship."

178. The award being made strictly in accordance with the result of an examination, there is no provision for taking account of Original Research in the estimate of the merit of a candidate. Mr. Jellett observes on this point: "The thing I know has been talked of Qu. 12,759.
"several times, but we never could see a practical way of carrying out such a thing."

179. It is understood that the emoluments of a Senior Fellowship in Trinity College, Dublin, are much greater than at Oxford or Cambridge. As regards the Junior Fellows, their income is, to a great extent, dependent upon their being all engaged in College work. Mr. Jellett says, "All our Fellows are engaged in teaching. We have no Qu. 12,754.
"Fellowships of the nature that they have at Oxford and Cambridge; they are more

" of the nature of prizes. We take a man's life, and we require him to give his life " to it."

180. Formerly, there was a certain number of Non-Tutorial Junior Fellowships, but now all the Junior Fellows have to give lectures, whether they be Professors or not. As the staff is large, and the lectures of the Fellows naturally harmonise with their own Qu. 12,755. pursuits they, or, at least, many of them, have a good deal of leisure, and have, therefore, an opportunity of engaging in Original Research, which is by no means neglected.

181. A Junior Fellow may look forward to succeeding in time to the seniority. The Senior Fellows are exempt from the duty of lecturing, but, with the Provost, form a Board to which, within the limits prescribed by the Statutes, or by any Regulation made by the Senate at large, is entrusted the General Management of the University. On this Board devolves also the Duty of Examining for Fellowships, Scholarships, and Sizarships; but it is at liberty to avail itself of the aid of Assistant Examiners chosen from among the Professors or Junior Fellows. Such, at least, were the rules prior to the Establishment of the New Council.

The Professoriate.

182. Most of the Professorships in the University of Dublin, which are of ancient foundation, were established to promote the study of Divinity or Literature, but several have of recent years been founded in various branches of Science, and the University possesses the power of establishing additional Professorships as they may seem to be required. The following is a list of the Scientific Professorships at present existing, including therein those which refer to Professional Studies of a Scientific Nature :—

Designation of Professor.	Foundation of Professorship.	
Regius Professor of Physic	1761	
Lord Donegal's Lecturer in Mathematics,*	about 1660	
Astronomer Royal of Ireland	1791	
Erasmus Smith's Professor of Natural and Experimental Philosophy	1724	
Erasmus Smith's Professor of Mathematics	1762	
University Professor of Natural Philosophy	1847	
Regius Professor of Surgery	1852	
Professor of Anatomy and Surgery	1785	These Professors are appointed by Trinity College, but belong to "the School of Physic in Ireland," which is a Medical School formed by an amalgamation of the Schools of Trinity College and of the College of Physicians. It was constituted by the Statute of 10th Geo. III. c. 84. and brought into its present form by the Statute of 30th Vict. c. 9.
Professor of Chemistry	1785	
Professor of Botany	1735	
Professor of Surgery	1849	
University Anatomist	1873	
Professor of Comparative Anatomy	1872	
Professor of Zoology	1871	
Professor Extraordinary of Civil Engineering	1842	
Professor of Geology	1844	
Professor of Applied Chemistry	1844	
Professor of Mineralogy	1845	
Professor of Civil Engineering	1852	

The Council.

183. Prior to the issue of Letters Patent, dated the 4th of November 1874, the Board, formed of the Provost and Senior Fellows, was the sole Governing Body of the College, and, practically, to a considerable extent, of the University. To it was committed the regulation of the Studies, Lectures, and Examinations preliminary to obtaining Degrees in

---

* This Lectureship is now held by the Assistant to Erasmus Smith's Professor of Mathematics.

Arts or Faculties in the University, and the appointment and election of Professors. But by the Letters above mentioned, a Council has been established to co-operate and have a share in the Regulation of the Studies, Lectures, and Examinations of the College, and in the Appointment and Election of Professors, and the Regulation of the tenure of office and of the duties of such Professors.

184. The Council consists of seventeen members, the Provost (or in his absence the Vice-Provost) being *ex officio* Member and Chairman, and the remaining sixteen being elected out of the Members of the Senate, or Public Congregation of the University, four by the Senior Fellows, four by the Junior Fellows, four by the Professors who are not Fellows, and four by those Members of the Senate who have not voted, nor been entitled to vote, at the last Election of any existing Member of the Council, either as Senior Fellows, as Junior Fellows, or as Professors.

185. The Council has the nomination to all Bursarships, except those, the nomination to which is provided for by Act of Parliament, or by the Directions of Private Founders.

186. The nomination of the Council is subject to the approval of the Board, except in the case of Bursarships in the School of Divinity. If the Board should refuse to approve a nomination of the Council, the decision rests with the Chancellor.

187. It is also provided, with certain exceptions, that any new Rules or Regulations, and any alterations in existing Regulations respecting Studies, Lectures, and Examinations, or respecting the qualifications, duties, and tenure of office of any Professor, shall require the approval both of the Board and of the Council.

Museums and other Scientific Institutions.

188. The following Museums are used for the purposes of Practical Instruction in Trinity College: the Museum of Natural Philosophy; the Museum of Zoology and Archæology; the Museum of Geology and Mineralogy; the Museum of Engineering Models; the Museum of Anatomy, Materia Medica, and Midwifery; the Museum of Botany. In connexion with the last must be mentioned the College Botanic Garden, which is situated about a mile from the College, and contains eight acres of ground.

189. About 20 years ago the College erected a handsome and commodious building in the College Park to contain their collections, and to provide working rooms for the Students.

Trinity College has three Chemical Laboratories. The first of these is intended for the use of the Professor and for Original Research. The second, or Student's Laboratory, is entirely devoted to Students who are learning Chemistry as a Practical Science. It is capable of accommodating 56 Students. The third Laboratory is attached to the Lecture Theatre in Applied Chemistry, and belongs more especially to the Engineering School.

190. The University possesses an Astronomical Observatory, which is available for the Instruction of Students. The Professor of Astronomy has charge of the Observatory, and is the Royal Astronomer of Ireland. This Office was founded in 1783, and since that date has been held by such distinguished men as Dr. Brinkley, Sir William Rowan Hamilton, and Dr. Brünnow.

Professor Jellett informs us that "The Astronomical Observatory has lately received "large additions and improvements. The large object glass presented to Trinity "College by Sir James South has been mounted as an Equatorial in an Observatory "specially constructed to receive it, and a new Meridian Circle, with all the modern "improvements, and carrying a telescope of six inches aperture and eight feet focal "length, has been ordered from Messrs. Pistor and Martin, of Berlin, and is expected "to be completed in the course of the next month."

Minutes of Evidence, Vol. II., Appendix V., p. 17.

There is also an Observatory, "erected for the special purpose of Observations "in Meteorology and Terrestrial Magnetism. In this Observatory an elaborate series "of Observations at stated hours has been carried on during a lengthened period; and "the Results of these Observations for the first eleven years have been recently "published in two quarto volumes."

Minutes of Evidence, Vol. II., Appendix V., p. 17.

191. There is at present no Laboratory specially appropriated to Physics. The University Authorities appear to be fully conscious of this defect in their Scientific Arrangements, and the erection of a Physical Laboratory on an extended scale is in contemplation.

General Remarks.

192. In Trinity College, Dublin, as in the old English Universities, the prospect of obtaining a Fellowship furnishes the highest class of Students with a powerful motive

for exertion, and the studies for proficiency in which Fellowships are usually awarded accordingly attract special attention. The proportion of Students who are directly influenced by such considerations must, however, be considerably smaller at Trinity College, Dublin, than at Oxford or Cambridge. For not only are the Fellowships much less numerous, in proportion to the number of Students, than at the English Universities, but, inasmuch as they are tenable for life, irrespective of marriage, the succession is slower; nor could this state of things be changed without an entire remodelling of the System of Fellowships, which we do not think desirable. The great mass of Students, and even of the more promising Students, must, therefore, soon perceive that they have no chance of obtaining a Fellowship.

193. Accordingly, any alteration in the studies which have a predominant influence in the award of Fellowships would, at least in its direct influence, affect only a much smaller number of Students than at Oxford or Cambridge. Indirectly, no doubt, such change would not be without influence, for the fact that the most powerful minds are turned towards particular studies by preference, must tend to commend those studies to the great mass of the Students.

194. The rarity of vacancies renders it exceedingly difficult to reward by election to a Fellowship proficiency in any one of a variety of branches of study. There is probably but one Fellowship to be bestowed in a year, and if one or two great branches of study are selected as exercising a predominant influence, highly qualified candidates are sure to present themselves; and it would be a matter of extreme difficulty to compare first-rate claims in three or four different great branches of study.

195. We think, however, that it would be very desirable that in the election to Fellowships important Original Research should be regarded as a substantial Element of Merit; and we believe that if this were done, it would be possible, without lowering the Standard of the Examination, to enlarge the Range of the Scientific Subjects included in it. We have already mentioned that the subject has not been overlooked by the University Authorities, though hitherto no practical method of dealing with it has presented itself.

196. From their Tenure and the Conditions of their Award, one object for which the Studentships are designed would seem to be, to assist those who are reading for Fellowships. The subjects, therefore, for which they are chiefly awarded naturally agree with those which enter into the Examination for Fellowships.

197. The number of Foundation Scholarships, however, annually awarded is much greater, and there appears to be no reason why they should all follow in the line of the Fellowship Examination, and be either mainly for Pure and Applied Mathematics, or else mainly for Classics. We think that some Foundation Scholarships might well be assigned as a reward for eminent proficiency in Physical or Biological Science.

IV.—The Queen's University in Ireland.

Foundation and Administration.

198. The Queen's University in Ireland was founded by Royal Charter, dated the 3rd of September, 1850. A Supplementary Charter was granted on the 17th of July, 1851; but, subsequently, both these Charters were revoked, and a New Charter was granted on the 8th of October, 1864, under which the University is at present constituted.

199. The circumstances which led to the Foundation of the Queen's University are well known, and need not be referred to here. They are sufficiently indicated by the Provisions which prohibit the University from imposing any Religious Test, from Granting any Distinction whatever or any Degree in Theology, or even from admitting any person to a Theological Examination.

200. The General Legislation, Government, and Administration of the University under the Charter, and in cases not provided for by it, are vested in the Senate of the University. The Senate consists of nineteen persons nominated, in the first instance, by the Crown, and holding their offices at the will and pleasure of the Crown. As vacancies arise, the Charter provides that every alternate vacancy shall be filled by the Convocation of the University until six places in all have been so filled up. The Senators elected by Convocation are to be elected from the Members of Convocation not holding office in any of the Colleges of the University, and each Senator so elected holds office for three years from the date of his election, or during the will and pleasure of the Crown. Outgoing Senators may be re-elected.

201. The Convocation of the University consists of the Chancellor, Senators, Secretary, Professors, and Registered Graduates of the University for the time being; all Graduates of two years' standing being entitled to register. The Powers of Convocation, besides that, already referred to, of appointing six Senators, are extremely limited. They have, however, the right of discussing any matter whatsoever relating to the University, and of declaring the opinion of Convocation thereon; due notice being given, a week previously, of any such discussion. But it is expressly provided that Convocation shall not be entitled to interfere in, or to have any control over, the affairs of the University.

202. The principal duty of the Senate is to make Byelaws and Regulations touching the Examinations and Qualifications for Degrees, and other University Distinctions; such Byelaws have, however, to be submitted to the Lord-Lieutenant, and to be approved of by him.

203. The three Queen's Colleges at Belfast, Cork, and Galway were founded at the same time as the Queen's University, and are declared in its Charter to be Colleges of the University. The Presidents of the three Colleges are, *ex officio*, Members of the Senate. Each of the Colleges has a Charter of its own, and, in all matters of internal government, is independent of the others, and of the University. The Governing Body of each College consists of a President, and of a Council composed of six Professors elected by the Professors of the College.

Course of Study and the Examinations.

204. In its general outlines the Course of Study in the Colleges is regulated by the Byelaws of the Senate, which determine the character of the University Examinations, but the manner in which the Students are to be prepared for these Examinations is left entirely to be arranged by each College. The Degrees of the University are granted only to Students who have resided and have gone through a Course of Instruction in one of the three Colleges. The Medical Degrees form, to a certain extent, an exception, as only one year of study in a Queen's College is required from a Candidate for a Medical Degree, and the remainder of his instruction may be obtained in any other Medical School. The Professors in the three Colleges have, by Charter, the *status* of Professors of the Queen's University, and conduct the University Examinations in that capacity, although they lecture only in their capacity as College Professors. Thus, the Examinations are under the immediate control of the University, but the Teaching in the Colleges is so only indirectly. Nevertheless, Sir Robert Kane contends that the Queen's University "may be regarded quite as much as the University of Edinburgh, or the Qu. 13,204.

"University of Oxford or of Cambridge, to be strictly and properly a Teaching "University." "We attach," he adds, "some importance to that question" . . . . .
Qu. 13,206. "The Colleges are Colleges of the University, not, as in the London University, "where the Degrees are given to any person who presents himself, and who chooses to "pass through certain Examinations, without reference to whether he has ever gone "through any really Educational Course in a Collegiate Institution or not."

205. The Queen's University grants Degrees in Arts, in Law, in Medicine, and, besides, the Degree of Bachelor in Engineering. For the Degree of Bachelor in Arts, the Student has to pass two University Examinations, called, respectively, the First University Examination in Arts and the Degree Examination in Arts. The Pass Examination in the First University Examination in Arts includes Greek, Latin, a Modern Continental Language, and Mathematics and Mathematical Physics. For the Degree Examination in Arts, the Student has to select a certain number of subjects from a list prescribed by the Senate. The Degree of Bachelor of Arts is attainable without any knowledge of Science beyond that included in the Course of Mathematical Physics, which comprises Mechanics, Hydrostatics, Optics, and Elementary Astronomy, as treated in very elementary works.

206. In addition to these Examinations, each College imposes a Matriculation or Entrance Examination, and Sessional or Class Examinations. No Student who does not pass the Matriculation Examination is admitted to the College, and no Student who does not pass the Sessional Examination or a Supplemental Examination, which is held to provide for cases of failure in the Sessional Examination, is allowed to count his Session, but is obliged to go through the course of study of that year over again. It is stated, in the Evidence, that the Sessional Examinations for promotion are conducted very strictly, so that, for example, in the Examination held in Cork at the close of the Session of 1870–1,
Qu. 13,208. "in the Faculty of Arts, out of a total of 50 Students, 23 were promoted and 27 were "not promoted. . . . . In the Faculty of Law there were nine Students, of whom five "were promoted and four were not promoted. In the Faculty of Engineering, out of "30 Students, 14 were promoted and 16 were not promoted; so that of 89 Students, 42 "were promoted and 47 were not promoted; but a large number of that 47 would get "in in October, by means of the Supplemental Examination."

The University Examinations are all held in Dublin. Formerly they used to be conducted in the Colleges, although by the University Professors, and on papers sent down from the University; but it has been now arranged by the Senate that even at the
Qu. 13,207. First University Examination all the Students must be examined in Dublin. This, it is stated, has been found more conducive to the proper conduct of the Examinations, and to the convenience of the Students themselves. The Standard of the University Examinations is said to be fully as high as the Standard in Trinity College, Dublin. Qu. 13,189.

207. So far as the Degrees in Arts, Law, and Engineering are concerned, the Examining Body is entirely composed of the Professors, acting not as College Professors, but as
Qu. 13,214. University Professors. "The three Professors in each branch of Science or Letters, for "instance, the three Professors of Chemistry, or the three Professors of Mathematics, "form a Board of Examiners, and the Examination Papers are prepared in common, a "portion of the papers being prepared by each Professor. Then the Students are "examined on those papers, and the value of the answers is judged by the Professors "conjointly acting together." With regard to the Medical Degrees, those parts of the Examination which refer to Practical Medical Subjects are conducted by outsiders.
Qu. 13,215. "The University Senate reserve to themselves the power of appointing any Examiners "that they wish, and, generally speaking, they appoint some of the most eminent Dublin "men from the Dublin Medical Schools to examine. They consider that they probably "get a somewhat higher class of Medical Practitioners from Dublin than they could "get from merely provincial towns, and also remove the suspicion of partiality in the "Professors examining their own pupils."

Scholarships.

208. In each of the Colleges there are forty-six Junior Scholarships—thirty of the value of 24*l.* each, for Students pursuing the Course prescribed for the Degree of A.B.; eight of the value of 25*l.*, for Students pursuing the Course prescribed for the Degree of M.D.; three of the value of 20*l.*, for Students in Law; and five of 20*l.*, for Students of Civil Engineering. The Junior Scholarships are awarded annually, by a General Examination, and are tenable for one year only, with the exception of those awarded to Students in Arts of the second year, which are tenable for two years. The Scholars of any year are not disqualified from being candidates for Scholarships the succeeding year. There are also in each College eight Senior Scholarships, of the value of 40*l.* a year, of which

one is given each year to Greek and Latin, one to Modern Languages and Modern
History, one to Mathematics, one to Natural Philosophy, one to Metaphysical and Econo-
mical Sciences, one to Chemistry, one to Natural History, and one to Law. All Graduates
in Arts of the Queen's University are eligible to the Senior Scholarships; these
Scholarships are awarded by examination, and are tenable for one year only, the Scholar
not being re-eligible. Certain duties are imposed both upon the Junior and the Senior
Scholars, the Senior Scholars in particular being required to assist the Professors in the
Matriculation and Class Examinations, and in conducting the business of the special
Departments of Literature and Science to which their Scholarships severally belong. They
are also required to pursue, under the superintendence of a Professor, an Advanced Course
of Study in one or more of the branches in which they have been examined for the
Scholarship. If no candidate of sufficient merit presents himself, the Scholarship (whether
Senior or Junior) is not filled up During the five years, from 1866–67 to 1871–72, "in Qu. 13,209.
" the Faculty of Arts the total number of Scholarships available was 185, that is, including
" both Senior and Junior Scholarships taken altogether, and the number awarded was
" 129, or 69½ per cent. In the Faculty of Arts there were, thus, only seven-tenths of the
" Scholarships conferred. In the Faculty of Medicine, out of 40 Scholarships available,
" in the five years, there were 35 conferred. In the Faculty of Engineering, out of 25
" available, 22 were conferred; and in the Faculty of Law, out of 20 that were available,
" 19 were conferred; and the total result was, out of 270 Scholarships, 205 were given,
" or it may be taken as 76 per cent. of the Scholarships. Those 270 Scholarships, in
" the five years, were competed for by 1,190 Students, which gives an average of about
" five Students competing for each Scholarship." It is unquestionable that young men
of ability are attracted to the Queen's Colleges by the probability of obtaining these
Scholarships, and we may infer from the Evidence that the Standard of Instruction in the
Colleges would be much lower if it were not for the presence of this class of Scholars.
Thus, Professor Purser states, "My principal difficulty arises from the widely different Qu. 13,256.
" degrees of progress Students have made before they enter College. We grant, in
" Queen's College, Belfast, Scholarships to Students at entrance, and half of them are
" given for attainments in Pure Mathematics. These are very eagerly competed for, and
" consequently we find a contingent of the Students come up well prepared. On the
" other hand, the greater number of the Students in Arts know but the first elements
" of Mathematics."

209. Besides the Junior and Senior Scholarships, to which reference has just been made, a certain number of Exhibitions and of Prizes has been established in the Queen's University with funds raised by a public subscription originated by Sir Robert Peel in 1861. In the Faculty of Arts there have thus been provided three Exhibitions of 20*l.*, three of 15*l.*, and two of 10*l.*, all tenable for three years. In the Faculty of Medicine, and also in the School of Engineering, there are each year two exhibitions, one of the total value of 40*l.*, the other of 30*l.* All these Exhibitions are given away, in accordance with the Results of the University Examinations, to Students who satisfy certain conditions as to standing, &c. Some of the Exhibitions are assigned in equal proportions to the three Colleges; the remainder are competed for by Students in any one of the three. They have not been established in perpetuity, but only for a period of 10 years. A fund, however, amounting, at present, to 3,408*l.* is being raised with a view to the future continuance of the endowment.

NUMBER OF STUDENTS.

210. The Number and Distribution of Students under Instruction in the Queen's Appendix
Colleges in Ireland in the Session 1873–74, was as follows:— VII., p. 74.

—	Belfast.	Cork.	Galway.
In the Faculty of Arts - - -	118	64	55
" Law - -	26	7	9
" Medicine - -	205	170	83
School of Engineering - - -	20	19	10
Not pursuing any special Course or Faculty	13	—	8
	382	260	165
Attending two Faculties - - -	7	10	9
Total Number of separate Students -	375	250	156

Appendix VII., p. 74. 211. The Number of Students in the Session 1874–75, was as follows:—

	Matriculated.	Non-Matriculated.	Total.
Belfast	345	47	392
Cork	226	23	249
Galway	148	6	154

Qu. 13,302. 212. At the Queen's College, Belfast, the number of Arts Students showed a tendency to diminish during the eight or ten years preceding 1872–73. Two causes are assigned for this falling off by Professor Purser: (1), "that the number of Candidates for the Presbyterian Ministry has of late years diminished," whereas such Candidates usually took the Arts Course in the Queen's College before entering the Presbyterian Theological College; and (2), that during a period of commercial prosperity, there is an inducement to prepare young men for trade and business rather than for a profession. A decided increase is shown by the Returns for 1873–74, and 1874–75. Appendix VII., p. 74.

THE SCIENTIFIC CHAIRS.

213. The following are the Professorships of Science in each of the Queen's Colleges:—Mathematics, Natural Philosophy, Chemistry, Natural History, Civil Engineering, Geology and Mineralogy, Anatomy and Physiology. In Belfast, there is a Professor of Agriculture, and, on the other hand, the Professorship of Natural History is united with the Professorship of Geology and Mineralogy.

214. The stipends of the Professors are partly derived from a fixed salary and partly from the fees of the Students. The fixed salaries vary from 150*l*., in the case of the Medical Professors, to 330*l*. in the case of the Professors of subjects included in the Arts Course.

APPLIANCES FOR TEACHING.

215. With regard to the appliances for teaching, the Evidence tends to show that they are in some respects insufficient. Each College receives 7,000*l*. a year from the Consolidated Fund, but this amount is entirely appropriated to the payment of the stipends of the Professors and of the other Officers of the College. In addition to this, there is an annual Parliamentary Grant of 1,000*l*. a year to each of the Colleges at Cork and Galway, and of 1,374*l*. to the College of Belfast, out of which the whole of the establishment expenses of the Colleges, and any augmentations of the Museums, Libraries, or Collections of Apparatus have to be provided. The annual grant was originally 1,600*l*. a year, but it was reduced to the present amount about ten years ago, when the inadequacy of the Professorial Salaries was brought under the notice of the Government. The salaries were augmented, but the funds required for the augmentation were obtained by trenching on the only resources available for the supply of apparatus and books.

Qu. 13,307. 216. With regard to Belfast, it is stated that the apparatus in the Laboratory of the Professor of Chemistry, if fully maintained, would be sufficient for the Practical Instruction of the Students, but that to maintain it properly with the present funds of the College is hardly possible. Qu. 13,304.–6. It may be mentioned that at Belfast a fee of 3*l*. is charged to those Medical Students who attend a Summer Course in Practical Chemistry. But the Students who go through a more extensive course of training in the Chemical Laboratory are elected by Examination, and are admitted gratuitously by Professor Andrews, who not only himself pays the salaries of the Assistants, but also provides gratuitous instruction to such Laboratory Students. The apparatus at the disposal of the Qu. 13,308. Professor of Natural Philosophy is described as decidedly inadequate. Qu. 13,329. Professor Cunningham, who holds the united Professorships of Natural History and Geology and Qu. 13,330. Mineralogy, says that there is "a museum in which the Geology and the Zoology are "best represented, upon the whole, but we have a very fair Herbarium of British Plants, "and there is the Botanical Garden belonging to the town, which allows us specimens of "plants during my course, on payment of a certain sum by the College to the Garden." The Professor has no Assistant, and his share of the annual grant of 1,000*l*. is about 50*l*. or 60*l*. The Senior Scholars who are required to assist the Professors are not found to Qu. 13,340. supply adequately the place of regular Assistants. Professor Cunningham says, "I have "a Senior Scholar, who is appointed annually in my Department, and he is supposed to

" give me some help when I call upon him to do so in connexion with other duties. If
" he is a very good man, I may occasionally get a little help from him in the Museum,
" but nothing very essential." And Professor Purser states that it is " exceedingly Qu. 13,256.
" difficult for the Professor to teach all [the Mathematical Students] at the same time.
" I and my predecessors have endeavoured to meet this difficulty, to a certain extent, by
" making use of the Senior Mathematical Scholar, a Graduate who has been elected to a
" Scholarship for one year after taking his Degree. I have derived in this way much
" valuable aid from the Senior Scholars, but such aid is quite insufficient, and a regular
" and permanent Assistant to my chair is most urgently needed, to render the training
" in the Mathematical School thoroughly efficient." Nor are the services of the Senior Qu. 13,257.
Scholars always really at the disposal of the Professor. " In many cases the Seniot
" Scholars are studying for a Profession or some Civil Service Appointment, and it
" becomes very irksome to them to have their time drawn upon to any large extent,
" and the College feel a difficulty in doing so."

217. In Cork similar deficiencies exist. Sir Robert Kane states that of the grant of 1,000*l.*
annually voted by the House of Commons (to which must be added about 100*l.* derived
from fees paid by the Students to the College), no less than 550*l.* were absorbed by the
Establishment and Administration Expenses of the College in the year ending the 31st of
March 1872, leaving for the whole of the Scientific and Literary Departments only about
500*l.* This is a sum which must be regarded as totally insufficient, when it is considered
that there are four Literary Departments to be conducted, and Collections of Books to
be kept up in a satisfactory state, besides the several Scientific Departments. Sir Robert
Kane adds, " we have done our best with the funds that were at our disposal for pro- Qu. 13,226.
" viding apparatus and illustrations of all kinds, but we have been obliged to do it with
" such parsimony, I may say, that we are possessed only of the material that is absolutely
" indispensable for anything like proper teaching." . . . . . " We have no means Qu. 13,227.
" whatever at our disposal for advancing Science. All that by any possibility we can
" pretend to do, is, so far as our means allow, to represent to the Students the
" actual condition of Science, but we have no means whatsoever by which we could
" pretend to advance it." At Cork, however, the Departments of the Natural History
Museum are described, with one exception, as being in a tolerably satisfactory condition.
There has been formed in the grounds of the College " a small garden containing
" such plants as are useful in illustrating Lectures on Botany and on Materia Medica Qu. 13,202.
" in the Medical School, as will grow in the open air in these countries, but we have
" no conservatories. We have had no funds available for the purpose, and the Govern-
" ment has never conceded to us the means of erecting a stove house, in which we could
" have a collection of such Tropical or Sub-Tropical Forms as would render our illustra-
" tions of living plants more complete. * * * * That is, I think, almost
" the only point in which our means of illustration in Natural History, or at least in
" Botany, is defective."

218. In Galway the Chemical Laboratory is described as adequate, and the Museum
of Natural History is tolerably well supplied with Zoological and Botanical Specimens,
and with Diagrams. " The Geological Museum is well supplied with fossils, which
" are ranged stratigraphically; there is a very good supply of rocks, both native Qu. 13,155.
" and foreign, and of course Irish; and there is a very good supply of models of
" crystals, along with diagrams and geological maps and sections, that are used for
" lecturing purposes." There is no Practical Instruction in Physics.

Conclusion and Recommendations with regard to the Queen's University in Ireland.

219. In Founding the Queen's Colleges, the State did not adopt the Principle of Assisting and Stimulating Local Efforts, and if we except the Exhibitions and Prizes, to which reference has been already made, as having been provided by public subscription, and a few other Exhibitions which have been founded at Belfast, no voluntary contributions have been received by them. They are Institutions for which the State has made itself responsible, and in which, as part of an University System, a complete Scientific Traiining is implied.

220. As we think it of great importance that the sanction of the State should not be given to the Teaching of Science on a scale inadequate to ensure its efficiency, we recommend;

I. That an increased Annual Grant be made to the Queen's Colleges for the purpose of providing Assistants, Apparatus, and the other necessary Appliances of Practical Scientific Teaching.

We further recommend :

II. That the Professorship of Natural History in the Queen's College, Belfast, be separated from that of Geology and Mineralogy.

All of which we humbly beg leave to submit for Your Majesty's gracious consideration.

(Signed) DEVONSHIRE.
LANSDOWNE.
JOHN LUBBOCK.
JAMES P. KAY-SHUTTLEWORTH.
BERNHARD SAMUELSON.
W. SHARPEY.
THOMAS H. HUXLEY.
G. G. STOKES.
HENRY J. S. SMITH.

J. Norman Lockyer,
Secretary.

June 18th, 1875.

APPENDICES.

LIST OF APPENDICES.

Pages.

APPENDIX I.

PAPERS RELATING TO THE UNIVERSITY OF LONDON - - - 43, 44
I. Correspondence relating to the Fees received in the Financial year 1874–75 - 43
II. Extracts from the Civil Service Estimates for the Financial Year 1875–76 - *ib.*

APPENDIX II.

PAPERS RELATING TO THE UNIVERSITIES OF SCOTLAND GENERALLY - 44, 45
I. Correspondence relating to the Amount at the disposal of the Commissioners under the Universities (Scotland) Act, of 1858 - - - - 44
II. Extracts from the Civil Service Estimates for the Financial Year 1875–76 - *ib.*

APPENDIX III.

PAPERS RELATING TO THE UNIVERSITY OF EDINBURGH - - - 46, 47
I. System of Examinations for Degrees in Science in the University of Edinburgh - 46
II. Non-Professorial Examiners in the Faculty of Medicine in the University of Edinburgh - - - - - - - - - 51–53
III. Statement of the total Emoluments of the Professors and Assistants, and Schedule of Lectures and Laboratory Instruction - - - - - 54–62
IV. The Number of Students attending the University - - - - 62, 63
V. Statement of the Fees payable by the Students - - - - 63–65
VI. The proposed New Buildings for the University of Edinburgh - - - 65–67

APPENDIX IV.

PAPERS RELATING TO THE UNIVERSITY OF GLASGOW - - - 67–69
I. Proposed Regulations for the Science Degree - - - - 67
II. Statement of the total Emoluments of the Professors and Assistants in the University of Glasgow, and Schedule of Lectures and Laboratory Instruction - 68
III. Number of Students at the University of Glasgow - - - - 69
IV. Fees payable by Students at the University of Glasgow - - - - 69

APPENDIX V.

PAPERS RELATING TO THE UNIVERSITY OF ST. ANDREW'S - - 70–72
I. Income of the University of St. Andrew's - - - - - 70
II. Statement of the total Emoluments of the Professors and Assistants in the University of St. Andrew's, and Schedule of Lectures and Laboratory Instructions - - - - - - - - - - 70, 71
III. Number of Students attending the University of St. Andrew's - - - 71
IV. Fees payable by Students at the University of St. Andrew's - - - 71, 72

APPENDIX VI.

PAPERS RELATING TO THE UNIVERSITY OF ABERDEEN - - - 72, 73
I. Correspondence between Her Majesty's Commissioners and the Principal of the University of Aberdeen - - - - - - - 72
II. Number of Students attending the University of Aberdeen - - - - 72
III. Fees payable by Students at the University of Aberdeen - - - - 73

APPENDIX VII.

PAPERS RELATING TO THE QUEEN'S UNIVERSITY AND THE QUEEN'S COLLEGES IN IRELAND - - - - - - - - 73, 74
I. Extracts from the Civil Service Estimates for the Financial Year 1875–76 - 73
II. Number of Students attending the Queen's Colleges in Ireland - - - 74

APPENDIX TO SEVENTH REPORT.

APPENDIX I.

PAPERS RELATING TO THE UNIVERSITY OF LONDON.

e para. 3. I.—CORRESPONDENCE relating tô the FEES received in the FINANCIAL YEAR 1874–75.

Royal Commission on Scientific Instruction and
the Advancement of Science,
6, Old Palace Yard, London, S.W.,
June 19, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to furnish, for the information of the Commissioners, a statement of the amount of the fees received by the University of London, and paid into the Exchequer, in the financial year 1874–75.

I have, &c.,
J. NORMAN LOCKYER,
Secretary.

Dr. Carpenter, F.R.S.

University of London, Burlington Gardens, W.,
June 22, 1875.

SIR,

IN reply to your letter of the 19th inst., I beg to inform you that the fees received by the University of London, and paid into the Exchequer, in the financial year 1874–75, amounted to 4,202*l.* 10*s.* 10*d.*

I am, &c.,
WILLIAM B. CARPENTER,
Registrar.

Norman Lockyer, Esq., F.R.S.

See para. 3. II.—EXTRACTS from the CIVIL SERVICE ESTIMATES for the FINANCIAL YEAR 1875–76.

	£
SALARIES AND WAGES	2,728
EXAMINERS	5,180
EXHIBITIONS, SCHOLARSHIPS, &c.	1,665
LAW EXPENSES	20
INCIDENTAL EXPENSES	475
	10,068

The Extra Receipts for 1875–76 are estimated at 4,000*l.*

DETAILS of the above.

A.—SALARIES AND WAGES:

Registrar	1,000
Assistant Registrar and Librarian	500
Clerk to the Senate	321
Supplemental Clerk	113
Occasional Assistance in the Office	40
Clerk of Convocation	200
Office-keeper	120
Porter	60
Housekeeper	75
Messenger and Printer	104
Messenger and Library Assistant	94
Assistant Messenger	24
Housemaid	39
Assistant Housemaid	13
Additional Attendance during Examinations and Meetings of Convocation	25
Total for Salaries, &c.	2,728

B.—EXAMINERS:

	£
Two in Classics, 200*l.* each	400
Two Assistant Examiners in Classics, 50*l.* each	100
Two in Mathematics and Natural Philosophy, 200*l.* each	400
Two Assistant Examiners in Mathematics, 50*l.* each	100
Two in Chemistry, 175*l.* each	350
Two Assistant Examiners in Chemistry, 30*l.* each	60
Two in Experimental Philosophy, 100*l.* each	200
Two Assistant Examiners in Experimental Philosophy, 25*l.* each	50
Two in Botany, 75*l.* each	150
Two in Geology and Palæontology 75*l.* each	150
Two in English Language and Literature, 120*l.* each	240
Two Assistant Examiners in English, 50*l.* each	100
Two in Logic and Moral Philosophy, 80*l.* each	160
Two in Political Economy, 30*l.* each	60
Two in the Text of Scripture, and Scripture History, 50*l.* each	100
Two in the French Language, 100*l.* each	200
Two Assistant Examiners in French, at 25*l.* each	50
Two in the German Language 30*l.* each	60
Two in Jurisprudence, Roman Law, International Law, and the Principles of Legislation 100*l.* each	200
Two in Equity and Real Property Law, 50*l.* each	100
Two in Common Law, and Law and Principles of Evidence, 50*l.* each	100
Two in Constitutional History, 25*l.* each	50
Two in Medicine, 150*l.* each	300
Two in Surgery, 150*l.* each	300
Two in Anatomy, 100*l.* each	200
Two in Physiology, Comparative Anatomy, and Zoology, 150*l.* each	300
Two in Obstetric Medicine, 75*l.* each	150
Two in Materia Medica and Pharmacy, 75*l.* each	150
Two in Forensic Medicine, 50*l.* each	100
Contingent Examiners	300
Total for Examiners	5,180

C.—EXHIBITIONS, SCHOLARSHIPS, PRIZES, AND MEDALS:—

Exhibitions at Matriculation:

	£	s.
One in June 1873, 30*l.* per annum, two quarters	15	0
One in June ,, 20*l.* ,, ,,	10	0
One in June ,, 15*l.* ,, ,,	7	10
One in Jan. 1874, 30*l.* ,, year	30	0
One in Jan. ,, 20*l.* ,, ,,	20	0
One in Jan. ,, 15*l.* ,, ,,	15	0
One in June ,, 30*l.* ,, ,,	30	0
One in June ,, 20*l.* ,, ,,	20	0
One in June ,, 15*l.* ,, ,,	15	0
One in Jan. 1875, 30*l.* ,, ,,	30	0
One in Jan. ,, 20*l.* ,, ,,	20	0
One in Jan. ,, 15*l.* ,, ,,	15	0
One in June ,, 30*l.* ,, two quarters	15	0
One in June ,, 20*l.* ,, ,,	10	0
One in June ,, 15*l.* ,, ,,	7	10

Exhibitions at First B.A. Examination:

One in 1873, 30*l.* per annum, two quarters	15	0
One in 1874, 40*l.* ,, year	40	0
One in 1874, 30*l.* ,, ,,	30	0
One in 1875, 40*l.* ,, two quarters	20	0
One in 1875, 30*l.* ,, ,,	15	0

Exhibitions at First B.A. and First B. Sc. Examinations:

One in 1873, 40*l.* per annum, two quarters	20	0
One in 1874, 40*l.* ,, year	40	0
One in 1875, 40*l.* ,, two quarters	20	0

Exhibitions at First B. Sc. and Preliminary Scientific M.B. Examinations:

Two in 1873, 40*l.* per annum each, two quarters	40	0
One in 1874, 40*l.* ,, year	40	0
Three in 1875, 40*l.* ,, each, two quarters	60	0

	£	s.
Exhibitions at First M.B. Examination:		
Two in 1873, 40*l.* per annum each, two quarters	40	0
Two in 1874, 40*l.* „ year -	80	0
Three in 1875, 40*l.* „ two quarters	60	0
Exhibitions at First LL.B. Examination:		
One in 1874, 40*l.* per annum, year - -	40	0
One in 1875, 40*l.* „ „ - -	40	0
University Scholarships in Arts:		
One in 1872, 50*l.* per annum, three quarters -	37	10
One in 1875, 50*l.* „ one quarter	12	10
University Scholarships in Science:		
One in 1873, 50*l.* per annum, three quarters -	37	10
Two in 1874, 50*l.* „ each, year -	100	0
Three in 1875, 50*l.* „ „ one quarter	37	10
University Scholarships in Arts and Science:		
One in 1873, 50*l.* per annum, year - -	50	0
Two in 1874, 50*l.* „ each, year -	100	0
Two in 1875, 50*l.* „ „ one quarter	25	0
University Medical Scholarships:		
Two in 1873, 30*l.* per annum, each, three quarters - -	45	0
One in 1874, 50*l.* per annum, year -	50	0
Two in 1874, 30*l.* „ „ „ -	60	0
One in 1875, 50*l.* „ one quarter -	12	10
Two in 1875, 30*l.* „ each - -	15	0
University Surgical Scholarships:		
One in 1874, 50*l.* per annum, year -	50	0
One in 1875, 50*l.* „ one quarter -	12	10

	£	s.
University Law Scholarships:		
One in 1874, 50*l.* per annum, year - -	50	0
One in 1875, 50*l.* „ „ - -	50	0
Prizes:		
At Matriculation, June, 1875 and Jan. 1876 -	40	0
„ First B.A. Examination, 1875 - -	20	0
„ B.A. Degree, 1875 - - -	30	0
„ Scriptural Examinations, 1875 - -	30	0
Medals:		
One Gold Medal at LL.D. Degree, 1876 -	20	0
„ M.D. „ 1875 -	20	0
„ M.S. „ „ -	20	0
Three „ M.A. „ „ 20*l.* each	60	0
Fourteen „ in Medicine „ „ 5*l.* each	70	0
	1,915	0
Deduct Amount that may not be payable	250	0
Total for Exhibitions, Scholarships, Prizes, and Medals - - -	£1,665	0

	£	s.
D.—Law Expenses - - - -	20	0
E.—Incidental Expenses:—		
Expenses at Scientific and Medical Examinations - - - - -	75	0
Maintenance of Library - - -	100	0
Advertisements - - - -	150	0
Sundries, including Postage, Carriage of Papers, and Expenses of Convocation -	150	0
Total for Incidental Expenses -	£475	0

APPENDIX II.

PAPERS RELATING TO THE UNIVERSITIES OF SCOTLAND GENERALLY.

See para. 22. I.—CORRESPONDENCE relating to the AMOUNT at the DISPOSAL of the COMMISSIONERS under the UNIVERSITIES (SCOTLAND) ACT OF 1858.

[In reply to a telegram.]

38, George Square, Edinburgh,
June 14, 1875.

SIR,

ON receipt of your telegram, asking me for documentary evidence regarding my statement that the Scottish Universities Commissioners (under the Act of 1858) were limited to the annual sum of 10,000*l.* to be voted by Parliament for the better endowment of the Scottish Universities, I wrote to the Lord Justice-General as by far the best authority on the subject. I have received (and with it permission to use it as I may think fit) the enclosed statement of facts in reply.

I beg leave to forward it for the use of the Royal Commission, and ask that it may be permitted to appear as an Appendix to my Evidence.

I am, &c.
P. G. TAIT.

J. N. Lockyer, Esq.

MY DEAR PROFESSOR, Edinburgh, June 10, 1875.

IN reply to your note of yesterday, I am unable to give you a reference to any Documentary Evidence in support of your statement, that the Universities Commissioners appointed by the Act of 1858 were limited to the sum of 10,000*l.* per annum as the amount of the total additions which they were to make to the Endowments of the Scottish Universities. But I can give you positive assurance of the fact. I was, as you know, Lord Advocate at the time, and obtained the sanction and consent of the Cabinet to the measure which I introduced, and which was passed in the Session of 1858, on the distinct condition that the additional sum to be provided by Parliament should not exceed 10,000*l.* per annum.

Afterwards, as Chairman of the Commissioners appointed by the Act, I had the best means of knowing that the Commissioners considered themselves to be limited by this condition, and would, but for this condition, have been disposed to draw much more liberally on the funds to be provided by Parliament.

It is highly probable that this matter forms the subject of a Treasury Minute, of which, I daresay, a copy could be obtained. But I never thought it of any importance to ask for any such evidence, because the arrangement between the Cabinet and myself was so distinct.

Believe me, &c.
JOHN INGLIS.

Professor P. G. Tait.

II.—EXTRACTS from the CIVIL SERVICE ESTIMATES for the FINANCIAL YEAR 1875–76.

	£
A.—UNIVERSITY OF ST. ANDREW'S	2,105
B.—UNIVERSITY OF ABERDEEN -	3,811
C.—UNIVERSITY OF GLASGOW -	3,165
D.—UNIVERSITY OF EDINBURGH -	6,804
	£15,885

DETAILS OF THE ABOVE.

A.—ST. ANDREW'S UNIVERSITY:

Principal* - - -	93	0	0	93
Professor of Ecclesiastical History - -	86	1	8	86
„ Hebrew and Oriental Languages	186	1	8	187
„ Divinity - -	87	0	0	87
United College of St. Salvator and St. Leonard:				
The Factor or Steward, for the use of the Principal and Masters - - -	157	17	0	158
Principal - - -	240	0	0	240
Professor of Greek - -	100	0	0	100
„ Logic - -	150	0	0	150
„ Moral Philosophy	150	0	0	150
„ Humanity -	120	0	0	120
„ Natural Philosophy	150	0	0	150
„ Mathematics -	109	0	0	109
„ Medicine -	100	0	0	100
„ Civil History -	100	0	0	100
„ Chemistry - -	125	0	0	125
Three Examiners - -	50	0	0	150
Total for St. Andrew's University				£2,105

---

* The present holder of this office receives 400*l.* a year as a Member of the Board of Education, Scotland, Class IV., Vote 10, Sub-head A.

B.—Aberdeen University :

	Salary.			Amount in Estimates.
Principal - - -	260	0	0	260
Faculty of Arts :				
Among 7 Professors and 4 Assistants - - -	821	6	8	821
Faculty of Divinity :				
Professor of Systematic Theology - -	82	0	0	82
„ Divinity and Church History -	123	0	0	123
„ Divinity and Biblical Criticism	20	0	0	20
„ Oriental Languages	103	0	0	103
Faculty of Law :				
Professor of Law - -	130	8	8	131
Faculty of Medicine :				
Professor of Institutes of Medicine - -	200	0	0	200
„ Practice of Medicine - -	150	0	0	150
„ Chemistry -	40	8	8	41
Assistants -	—			150
Class Expenses	—			100
„ Anatomy -	150	0	0	150
Assistant -	100	0	0	100
„ Surgery - -	150	0	0	150
„ Materia Medica -	150	0	0	150
Assistant -	50	0	0	50
Class Expenses	—			50
„ Midwifery -	150	0	0	150
„ Medical Jurisprudence - -	75	0	0	75
Class Expenses	—			35
„ Botany - -	300	0	0	300
Three Examiners in Arts -	80	0	0	240
Three Medical Examiners -	60	0	0	180
Total for Aberdeen University -				£3,811

C.—Glasgow University :

	Salary.			Amount in Estimates.
Principal - -	250	0	0	250
Professor of Anatomy -	30	0	0	30
„ Mathematics -	62	0	0	62
Assistant -	100	0	0	100
„ Moral Philosophy	11	0	0	11
„ Natural Philosophy	21	0	0	21
Assistant -	100	0	0	100
„ Greek - -	20	0	0	20
Assistant -	100	0	0	100
„ Logic - -	11	0	0	11
„ Medicine -	10	0	0	10
„ Oriental Languages	20	0	0	20
„ Humanity -	25	0	0	25
Assistant -	100	0	0	100
„ Astronomy -	50	0	0	50
„ Natural History -	200	0	0	200
„ Midwifery -	100	0	0	100
„ Chemistry -	200	0	0	200
Two Assistants	—			200
„ Surgery - -	100	0	0	100
„ Botany - -	100	0	0	100
„ Materia Medica -	100	0	0	100
„ Forensic Medicine	100	0	0	100
Assistant to the two preceding	50	0	0	50
„ Institutes of Medicine - -	150	0	0	150
„ Civil Engineering and Mechanics	275	0	0	275
Professor of English Language and Literature	200	0	0	200
Three Examiners in Arts -	80	0	0	240
Three Medical Examiners -	80	0	0	240
Total for Glasgow University -				£3,165*

D.—Edinburgh University :

	£	s.	d.	£
Principal† - - -	848	17	10	849
Professor of Greek - -	130	0	0	130
Assistant -	100	0	0	100
„ Moral Philosophy	130	0	0	130
„ Logic -	180	0	0	180
„ Humanity -	130	0	0	130
Assistant -	100	0	0	100
„ Mathematics -	80	0	0	80
Assistant -	100	0	0	100
„ Natural Philosophy	180	0	0	180
Assistant -	100	0	0	100
„ History - -	150	0	0	150
„ Church History -	100	0	0	100
„ Hebrew and Oriental Languages	215	0	0	215
„ Rhetoric and English Literature	200	0	0	200
„ Public Law -	250	0	0	250
„ Civil Law -	150	0	0	150
„ Natural History‡	160	0	0	160
„ Clinical Surgery	100	0	0	100
„ Surgery - -	100	0	0	100
„ Botany § - -	160	0	0	160
„ Institutes of Medicine - -	150	0	0	150
„ Practice of Physic	100	0	0	.00
„ Chemistry -	200	0	0	200
„ Midwifery -	100	0	0	100
„ Materia Medica ‖	100	0	0	100
„ General Pathology	100	0	0	100
„ Medical Jurisprudence - -	100	0	0	100
„ Practical Astronomy	300	0	0	300
„ Sanskrit - -	200	0	0	200
„ Civil Engineering ¶	200	0	0	200
„ Agriculture ** -	150	0	0	150
„ Geology, Mineralogy†† -	200	0	0	200
„ Theory and Practice of Teaching‡‡	200	0	0	200
Three Examiners in Arts -	80	0	0	240
Three Medical ditto - -	100	0	0	300
Maintenance and Repair of College Buildings - -	—			500
Total for Edinburgh University -				£6,804

---

* 800*l*. of this amount is in lieu of the lease of the rents of the Archbishopric of Glasgow, formerly held by the College.

† The present holder of this office receives also 400*l*. a year as Member of the Board of Education, Scotland, Vote 10, Class IV. Sub-head A.

‡ The present Professor of Natural History also receives 1,000*l*. a year as Director of the Scientific Staff of the Deep Sea Exploring Expedition, *see* Class VII., Vote 2, Sub-head A.

§ The present holder of this office has an allowance of 120*l*. a year in lieu of a house under Sub-head F. of this Vote.

‖ The present Professor of Materia Medica receives also 100*l*. a year as Visiting Physician at the General Prison, Perth, Vote 21, Class III., Sub-head D.

¶ This Professorship has been founded by a gift of 5,000*l*. from Sir David Baxter, Bart.

** Conditional on contribution of a similar amount by the Highland Society.

†† This Professorship has been founded by a gift of 6,000*l*. from Sir Roderick Impey Murchison, Bart. The present Professor has also a salary of 400*l*., rising by 25*l*. a year to 600*l*., as Director of the Geological Survey for Scotland, Class IV., Vote 2, Sub-head Q. 4.

‡‡ Endowed with 6,000*l*. by the Trustees of late Dr. Bell.

APPENDIX III.

PAPERS RELATING TO THE UNIVERSITY OF EDINBURGH.

I.—System of Examinations for Degrees in Science in the University of Edinburgh.
II.—Non-Professorial Examiners in the Faculty of Medicine in the University of Edinburgh.
III.—Statement of the total Emoluments of the Professors and Assistants, and Schedule of Lectures and Laboratory work.
IV.—The Number of Students attending the University.
V.—Statement of the Fees payable by the Students.
VI.—The proposed New Buildings for the University of Edinburgh.

See paras. 39–42.

I.—SYSTEM OF EXAMINATIONS for DEGREES in SCIENCE in the UNIVERSITY of EDINBURGH.

[In reply to a telegram.]

University of Edinburgh,
May 1st, 1875.

DEAR SIR,

UP to this time the Examinations for the Degrees in Science have been almost entirely conducted by the Professors, each Professor examining on his own subject. Some assistance has been given by the Non-Professorial Examiner in Natural History, and also by myself in the absence of the Professor of Natural History; but the Professors of the Scientific Subjects examined on are the responsible Examiners. I believe that the question of appointing additional Examiners, not Professors, for the Degrees in Science, has been under the consideration of the University Court; but in this, as in other matters affecting the University, useful reforms and advisable modifications are retarded through want of funds to pay the additional Examiners; for I should explain that the Professors examine without receiving any remuneration for their labour as Examiners, so that the University obtains the benefit of their services in that capacity without any cost. The number of Candidates for the Degrees in Science is as yet small, not amounting, I think, to more than eight or ten in the year; the fees also are small, so that the revenue derived by the University from this source is trifling.

See p. 51.

The University Court, however, has thoroughly recognised the principle of associating with the Professors additional Examiners who are not Professors, and has, as I explained in a former letter to the Commissioners, carried this out in the Examinations for Degrees in Medicine. I have no doubt that, did the funds of the University permit, the Court would appoint Non-Professorial Examiners for the Degrees in Science.

I hope that I have now accurately apprehended the question and given you the information required; but should the Commissioners still desire further information on this or other matters appertaining to the University, I shall be happy, so far as lies in my power, to supply it.

Believe me, &c.
J. N. Lockyer, Esq. W. TURNER.

P.S. Since writing the above I have seen Mr. Christison, the Secretary to the University Court, who informs me that there is doubt whether the Court has powers, under Ordinance No. 8, Section 5, as amended on 6th of August last, to call upon the Non-Professorial Examiners in Medicine to examine also for Degrees in Science. If the money difficulty, however, did not exist, the Court, by the powers it at present possesses, could at once provide Non-Professorial Examiners in Science.

W. T.

REGULATIONS FOR GRADUATION IN SCIENCE.

(From the University Calendar, 1875–76.)

[Referred to in Professor Turner's Letter of May 1st, 1875.]

Two Degrees in Science are conferred by the University of Edinburgh, viz., Bachelor of Science (B.Sc.) and Doctor of Science (D.Sc.). Both these Degrees are conferred in Physical and Natural Science, in Public Health, and in Engineering. In Mental Science and Philology, the Degree of Doctor of Science only is conferred.

SECTION A.—PHYSICAL AND NATURAL SCIENCE.

I. QUALIFICATIONS REQUIRED IN CANDIDATES.

1. Candidates for a Degree in Physical and Natural Science must give proofs of having received a liberal education by being either—

(*a.*) Bachelors or Masters of Arts, by examination, of British or recognised Colonial Universities.
(*b.*) Bachelors or Doctors of Medicine of British or recognised Colonial Universities.
(*c.*) Holders of two Departmental Certificates in the Faculty of Arts of this University.
(*d.*) Matriculated Students of the University of London, if certified for Greek and for Logic or Moral Philosophy.

2. Failing any of these qualifications, the candidate must pass a Preliminary Examination in English, Latin, Arithmetic, the Elements of Mathematics, and the Elements of Mechanics; and he must also pass an Examination on at least two of the following subjects: Greek, French, German, Higher Mathematics, Natural Philosophy, Logic, and Moral Philosophy.

Candidates for this Preliminary Examination are examined at the same time as those for entrance into the Study of Medicine. For further details as to the Preliminary Examinations, see Notices under "Medical Graduation" in the Calendar.

3. They must also produce evidence of attendance on qualifying Classes embracing the subjects included in the Science Examination which they purpose to undergo.

4. The attendance on such classes must extend over three Academic years, one of which must be passed at the University of Edinburgh, the other two years either at this University or at Universities or Institutions* recognised by and approved by this University.

5. Each Academic year must be constituted by attendance on Science Classes during at least two courses of not less than 100 lectures each, or one course of 100 lectures and two courses of 50 lectures each.

6. Every Candidate for a Degree in Science must be matriculated for the year in which he appears for Examination.

7. The First and Second Examination for Degrees in Science must in each case be taken at a single period.

II. EXAMINATIONS.

For the Degree of Bachelor of Science there are two Examinations, conducted by written questions, as well as orally and practically.

(a.) *First Bachelor of Science Examination.*

1. The First Examination for B.Sc. is as to the general knowledge of the Candidate on the following subjects, viz.:

Mathematics.	Zoology, including Comparative Anatomy.
Natural Philosophy.	Botany.
Chemistry.	

2. The Examinations in Mathematics and Natural Philosophy take place on the days of Examination for these subjects, announced in the Regulations for Graduation in Arts.

3. The Examinations in Chemistry, Zoology, and Botany take place at the same time as the examinations on these subjects, announced in the Regulations for Graduation in Medicine.

4. Exemptions from Examination:

(1.) Persons possessing the following qualifications are exempted from the whole of the First B.Sc. Examination:

α. Masters of Arts who have taken honours in the Natural Sciences after passing the examinations for M.A. in this University.

β. Bachelors and Doctors of Medicine and candidates for these Degrees who have taken honours in the Natural Sciences at their professional examinations in this University, and who have also passed with distinction in Higher Mathematics and Natural Philosophy in their extra-professional or preliminary examinations.

(2.) Holders of certificates from the classes devoted to any of the above subjects in Science in the University of Edinburgh, showing that the candidate obtained at least 80 per cent. of the available marks during the Session, will be exempted from the *written* examination on that subject.

(3.) Masters of Arts are exempted from Examination in Mathematics and Natural Philosophy.

---

* The Institution to be approved of by the University must be of a high class, such as the Royal School of Mines, London, the École Centrale, or the École des Mines, Paris.

(b.) *Second Bachelor of Science Examination.*

1. The Second B.Sc. Examination is divided into the following groups, one of which must be professed by the candidate :—

(*a.*) The Mathematical Sciences	Higher Mathematics, Natural Philosophy.
(*b.*) The Physical Experimental Sciences	Experimental Physics, Chemistry.
(*c.*) The Natural Sciences	Zoology, Botany, Physiology, Geology.

2. The Examinations in the first two of these departments (except in Chemistry) will take place at the same time as the Examination for the Degree of M.A., and in the last (and in Chemistry) at the same time as the Examination for the First M.B. Professional Examination.

3. A Candidate who has passed the First B.Sc. Examination may proceed to the Second after an interval of six months.

4. A Candidate who has passed the First and Second B.Sc. Examinations will be recommended to the Senatus for that Degree, which will be conferred at one of the usual times appointed for giving Degrees.

(c.) *Doctor of Science Examination.*

1. A Candidate who has received the Degree of B.Sc. may proceed to that of Doctor of Science, after a lapse of twelve months.

2. A Candidate for the Degree of D.Sc. must profess one of the above-mentioned sciences, of which he will be expected to have a thorough knowledge.

3. He must submit a Thesis containing some original Researches on the subject of his intended Examination, and such Thesis must be approved before the Candidate is allowed to proceed to Examination.

4. The Degree of D.Sc. will not be conferred on any Candidate who has not completed his 21st year.

III. FEES.

The following is the scale of fees which are charged for the Degrees in Science (sects. A. and B.) :—

1. For the Preliminary Examination, or for Registration of Qualification	£1	1	0
2. For the First Bachelor of Science Examination - - - -	2	2	0
3. For the Second Bachelor of Science Examination - - - -	2	2	0
4. For the Doctor of Science Examination - - - -	5	5	0
	£10	10	0

Candidates for Science Examinations should announce their names and addresses to the Registrar, and pay the fees, before the 5th of March or the 1st of October. In the event of a Candidate not passing either of the B.Sc. or D.Sc. Examinations in Sections A, B, and E, the fee is not returned; but he may appear at one subsequent examination without paying an extra fee, and at any future examination on paying one half of the fee.

IV. OUTLINE OF SUBJECTS REQUIRED IN EXAMINATIONS FOR DEGREES IN SCIENCE.

First Bachelor of Science Examination.

1. Mathematics.

Euclid, Books i.–vi., with the first twenty-one Propositions of Book xi.

Elementary Trigonometry and Conic Sections.

Elementary Algebra, including Progressions, Surds, the Binomial Theorem, &c.

2. Natural Philosophy.

(*a.*) Applied Mathematics, including the treatment by Elementary Geometry, Algebra, and Trigonometry, of the following subjects (such as may reasonably be acquired in one or two sessions' attendance at a course of Natural Philosophy):

Kinematics, including Velocity, Acceleration, Angular Velocity, Simple Harmonic Motion, &c., and their composition and resolution.

Abstract Dynamics, including Elementary Statics, Kinetics, Hydrostatics, and Hydrokinetics.

Geometrical Optics.

Plane Astronomy.

(*b.*) Experimental Physics, including—

Laws of Motion.

Properties of Matter.

Sound and Harmonics.

Light, with the fundamental principles of the Undulatory Theory.

Heat, with the fundamental principles of the Dynamical Theory.

Electricity, including the Experimental Laws of Static and Galvanic Electricity, Induction, Magnetism, and Electro-Magnetism.

Conservation of Energy as the experimental law of physical phenomena.

3. Chemistry.

Classification of Elements. General Laws of Chemical Combination and Action, as illustrated in the simpler compounds of the more commonly occurring elements. Symbolic Notation.

Preparation and Properties of the Non-Metallic Elements and their chief Compounds. Manufacture of Sulphuric, Nitric, and Hydrochloric Acids and Ammonia.

Classification and General Properties of Acids, Bases, and Salts.

Manufacture and Properties of Soda, Potash, Nitre, Gunpowder, Limestone, Lime, Mortars, Cements, Clay, Earthenware, Porcelain, and Glass.

Metallurgical operations in general. Preparation of Iron, Zinc, Copper, Lead, Tin, Mercury, and Silver, from their Ores. Principal salts of these metals. Alloys. Preparation, Properties, and Composition of Cast-Iron, Wrought-Iron, and Steel.

Classification of Organic Compounds. Alcohol, Acetic Acid, Wood, Sugars, Starch, Coal Gas, Coal-Tar, Oils, and Fats, Saponification.

Simple Quantitative Analysis. [The Examination in Analysis is conducted practically.]

4. Zoology, including Comparative Anatomy.

Distinctive characters of the three great Kingdoms of Nature.

Ideas involved in "Specialisation of Function" and "Morphological Type."

Homology and Analogy.

The general structure and physiology of the following groups of Animals :—

Mammalia, Aves, Reptilia, Amphibia, Pisces.

Insecta, Myriapoda, Arachnida, Crustacea, Annelida, Rotifera, Nematelmenthes, Platelmenthes.

Echinodermata.

Cephalopoda, Gasteropoda, Pteropoda, Lamellibranchiata, Brachiopoda, Tunicata, Polyzoa.

Actinozoa, Hydrozoa.

Infusoria, Rhizopoda, Sponginæ, Gregarinæ.

The candidate will be required to refer to its proper group, among those named above, any specimen which may be exhibited for this purpose by the Examiner.

Physical Geography, in so far especially as it is concerned with the geographical distribution of organic beings.

5. Botany.

Candidates to be examined on the structure and functions of plants, the principles of classification, classes, sub-classes, and sections of the Natural System, and a few of the principal Orders, as enumerated below.

Text Book—Balfour's Class Book, or his Manual of Botany.

More specific statement of Subjects.

Elementary Tissues of Plants, their chemical constituents, contents, and mode of development.

General characters and functions of the Root, Stem, Leaf, envelopes of the Flower, Stamen, Pistil, Fruit, and Seed.

Phyllotaxis, Inflorescence, Anthotaxis, Metamorphosis, Vernation, Æstivation, Stipulation, Placentation.

Respiration and Transpiration. Movement of Sap and its causes.

Embryogenic process in Phanerogamic and Cryptogamic Plants.

Germination. Propagation by Buds and by Division.

Classification of Plants: Cellular and Vascular Plants; Phanerogamous and Cryptogamous; Dicotyledons (Angiospermous and Gymnospermous); Monocotyledons; Acotyledons; Exogens; Endogens; Acrogens; Thallogens.

Botanical characters to be demonstrated on conspicuous specimens of the following Natural Orders :—

Ranunculaceæ, Papaveraceæ, Cruciferæ, Carophyllaceæ, Malvaceæ, Sterculiaceæ, Leguminosæ, Rosaceæ, Onagraceæ, Umbelliferæ, Dipsacaceæ, Compositæ, Campanulaceæ, Boraginaceæ, Labiatæ, Scrophulariaceæ, Primulaceæ, Euphorbiaceæ, Salicaceæ, Corylaceæ, Coniferæ, Cycadaceæ, Orchidaceæ, Amaryllidaceæ, Musaceæ, Liliaceæ, Palmæ, Cyperaceæ, Gramineæ, Filices, Musci.

Derivation and meaning of the more important Botanical terms.

Second Bachelor of Science Examination.

(*a*.) The Mathematical Sciences.

1. Mathematics.

Algebra, including the Theory of Equations.
Trigonometry, Plane and Spherical.
Analytical Geometry of two and three dimensions.
The Differential and Integral Calculus.

2. Natural Philosophy.

For the Second Examination, the same subjects will be taken as in the First, but they will be carried out with a higher application of Mathematics, and with a more strict examination into the candidate's acquaintance with the Experimental part of the subject.

(*b*.) The Physical Experimental Sciences.

1. Experimental Physics.

Candidates will be required to show considerable familiarity with the processes required for the determination of physical constants, such as, for instance, the Specific Heat, the Specific Inductive Capacity, the Thermal and Electric Conductivity of a substance, the Velocity of Light or of Sound; the Magnetic Dip, Variation, and Horizontal Intensity, &c., &c.

2. Chemistry.

The same subjects as for the first Bachelor of Science Examination, but carried out in greater detail, and in addition, the connexion between Chemical Composition and Crystalline Form, and Optical and Thermic Properties.

Complex Qualitative Analysis. [The Examination in Analysis will be conducted practically.]

(*c*.) The Natural Sciences.

1. Zoology, including Comparative Anatomy.

Same subjects as for First Bachelor of Science Examination, but carried out in greater detail.

2. Animal Physiology.

1. The alimentary substances appropriate for the food of animals.
2. The processes of mastication, insalivation, and deglutition.
3. Digestion in the stomach—the effect of the gastric juice upon the food, and the nervous influences acting on the stomach.
4. The functions of the liver.
5. The secondary digestion, and its influences on the blood.
6. The general functions of secretion.
7. Comparison of the structure and actions of the circulatory and respiratory organs in the various classes of animals.
8. The general functions of the nervous system.
9. Sensibility and sensation.
10. Muscular contractibility.
11. Functions of the cerebral lobe and of the cerebellum.
12. Functions of the spinal cord.
13. Theory of reflex or diastaltic functions.

3. Botany. (Specialised.)

Vegetable Histology, Vegetable Morphology, Vegetable Physiology, including Development.

Systematic Botany.—The structure and physiological characters of the principal Natural Orders of the Vegetable Kingdom.

Botanical Geography, Distribution of Plants in Britain.

4. Geology, including Palæontology and Mineralogy.

Physical Geography, Meteorology, and Dynamical Geology.—The nature and operation of Geological agents: Rain, Rivers, Ice, the Sea, Earthquakes, Volcanoes, Movements of Upheaval and Depression.

Mineralogical and Petrographical Geology.—Characters of Rock-forming Minerals: Composition, Origin, and Distribution of Rocks.

Structural Geology.—The Structure of Rock-masses: Joints, Bedding, Cleavage, Foliation, Metamorphism, Faults, Unconformability, Denudation.

Stratigraphical Geology.—The History of the Geological Formations of the British Islands.

Palæontological Geology.—Characters and Distribution in time of the more important Genera and Orders found fossil in Britain.

Doctor of Science Examination.

1. Mathematics.

The candidate will be required to show very high attainments in one of the following subjects:—

1. Geometry and Trigonometry.
2. Analytical Geometry.
3. Algebra.
4. The Differential Calculus generally.
5. Special departments, such as the Calculus of Variations, the Theory of Determinants, Quaternions, &c.

2. Natural Philosophy.

Candidates are required to pass a searching examination in one of the following subjects or groups of subjects (in all its details), and to show more than a mere elementary knowledge of at least two others:—

(A.) Applied Mathematics.

1. Abstract Dynamics, including Kinematics.
2. Acoustics and Theory of Light.
3. Conservation of Energy including the Dynamical Theory of Heat.
4. Electricity, including the mathematical theories of Static and Voltaic Electricity, Induction, Magnetism, and Electro-Magnetism.
5. Physical Astronomy, including the Lunar and Planetary Theories, the Figure of the Earth, Precession, and Nutation.

(B.) Experimental Physics, or Science of Observation.

6. Properties of Matter.
7. Sound and Light.
8. Heat and Energy (generally).
9. Electricity, Magnetism, &c.

(C.) Practical Astronomy.

1. Nautical Astronomy, and such applications of received science as are necessary in finding angular positions, as latitude and longitude, in voyaging over the surface of the globe.
2. Terrestrial Astronomy, and those processes, both of observation and computation, which are employed in determining the size and figure of the earth, as a base line for further measures.
3. Cosmical Astronomy, and the determination, by the most refined operations, of the distances, magnitudes, masses, and movements of the heavenly bodies.

In each of these branches, a knowlege of the principles of the usual instruments employed in them will be required; some observations with one at least of them, and upon one or more of the problems, must have been taken under the open sky; and practical ability shown, in eliminating by calculation instrumental and terrestrial errors, as well as in exhibiting the numerical value of the astronomical result, both with regard to what has been done by previous good observers in the same field, and to the predictions of the best theory.

3. Chemistry.

The candidate will be required to pass a searching examination in one of the following branches:—

1. The Chemistry and Chemical Technology of Inorganic Bodies, including Metallurgy.
2. Organic Chemistry.

And to show a thorough practical acquaintance with Chemical Analysis in all its branches.

4. Zoology, including Comparative Anatomy.

The more important special modifications, structural and physiological, in each of the groups included in the First Bachelor of Science Examination; and also the leading phenomena of development throughout the various classes of the Animal Kingdom.

5. Animal Physiology.

In addition to any of the subjects in the Bachelor of Science Examination—

1. Functions of the ganglionic system of nerves.
2. Functions of the elementary structures of the body.
3. General properties and functions of the blood.
4. General ideas as to vitality and vital functions.
5. The function of reproduction, and the phenomena of development.

6. Botany.

Structural and Physiological characters of the Natural Orders of the Vegetable Kingdom, together with a practical knowledge of the genera and species of some particular group to be selected by the candidate, and approved by the Examiners; along with Botanical Geography and Fossil Botany.

7. Geology, including Palæontology and Mineralogy.

In addition to a more searching test of the knowledge of the subjects prescribed for the Second Bachelor of Science Examination, Candidates will be required to show some acquaintance with the Geology and Palæontology of foreign countries as well as of the British Islands. It will be necessary that they evince sound practical knowledge. To test their acquirements in this respect, they will be asked to identify and describe specimens of minerals, rocks, and fossils placed before them; and from a geological map, which will be furnished to them, to write a paper (with sections) on the geology of the district to which the map refers.

J. H. BALFOUR,
ALEX. CRUM BROWN,
Joint Conveners.

SECTION B.—ENGINEERING.

The Degrees of Bachelor of Science and Doctor of Science are open to Candidates submitting themselves for examination in Engineering according to the subjoined Rules.

1. Candidates must also have the qualifications required by paragraphs 2, 3, 4, and 5 of Section A, p. 46.

2. There will be two Examinations in Science for the Degree of Bachelor of Science, and a third Examination for the Degree of Doctor of Science. The examinations will be written, oral, and practical.

3. The first examination is as to the general knowledge of the Candidate on the following subjects, viz.:—

Mathematics
Natural Philosophy.
Chemistry.

4. This examination is called the First Bachelor of Science Examination in Engineering, and is compulsory on all who do not possess the qualifications which entitle a Candidate to be exempted from the First Bachelor of Science Examination in Section A.

5. The Candidate who has passed the First Bachelor of Science Examination (or has the qualification necessary to exempt him from this Examination), may proceed to the Second Examination after an interval of six months. This is called the Second Bachelor of Science Examination. The Candidate will be examined in the following subjects:—

Mathematics applied to Mechanics.
Engineering.
Drawing.

6. The Candidate, after passing the Second Examination, shall be recommended to the Senatus for the Degree of Bachelor of Science.

7. A Candidate who has received the Degree of B.Sc., and who desires to proceed to the Degree of Doctor of Science, may present himself for a third examination, after the expiry of twelve months.

8. The Examinations for Degrees will be conducted by University Examiners, and an Examiner appointed by the University Court.

9. The Degree of D.Sc. will not be conferred on any Candidate who has not completed his 21st year.

First Bachelor of Science Examination.

(*a*.) Mathematics—
Arithmetic.
Algebra.—To the end of Quadratic Equations inclusive, with Progressions, the Binomial and Exponential Theorems, and Logarithms.
Geometry.—Equivalent to the first four and sixth Books of Euclid, and part of the eleventh.
Conic Sections, treated geometrically.
Plane Trigonometry.—Angles and Triangles, with their relations.
Analytical Geometry.—The Rudiments in two and in three Dimensions.

(*b*.) Natural Philosophy:
(*a*.) Applied Mathematics, including the treatment by Elementary Geometry, Algebra, and Trigonometry, of the following subjects (such as may reasonably be acquired in one or two sessions' attendance at a course of Natural Philosophy)—
Kinematics, including Velocity, Acceleration, Angular Velocity, Simple Harmonic Motion, &c., and their composition and resolution.
Abstract Dynamics, including Elementary Statics, Kinetics, Hydrostatics, and Hydrokinetics.
Geometrical Optics.
Plane Astronomy.

(*b*.) Experimental Physics, including
Laws of Motion.
Properties of Matter.
Sound and Harmonies.
Light, with the fundamental principles of the Undulatory Theory.
Heat, with the fundamental principles of the Dynamical Theory.
Electricity, including the Experimental Laws of Static and Galvanic Electricity, Induction, Magnetism, and Electro-Magnetism.
Conservation of Energy as the Experimental Law of Physical Phenomena.

(*c*.) Chemistry:
Classification of Elements. General Laws of Chemical Combination and Action, as illustrated in the simpler compounds of the more commonly occurring elements. Symbolic Notation.
Preparation and Properties of the Non-Metallic Elements and their chief Compounds. Manufacture of Sulphuric, Nitric, and Hydrochloric Acids and Ammonia.
Classification and General Properties of Acids, Bases, and Salts.
Manufacture and Properties of Soda, Potash, Nitre, Gunpowder, Limestone, Lime, Mortars, Cements, Clay, Earthenware, Porcelain, and Glass.
Metallurgical operations in general. Preparation of Iron, Zinc, Copper, Lead, Tin, Mercury, and Silver, from their Ores. Principal salts of these metals. Alloys. Preparation. Properties, and Composition of Cast-iron, Wrought-Iron, and Steel.
Classification of Organic Compounds. Alcohol. Acetic Acid, Wood, Sugars, Starch. Coal-Gas, Coal-Tar, Oils, and Fats, Saponification.
Simple Qualitative Analysis. [The Examination in Analysis is conducted practically.]

Second Bachelor of Science Examination.

(*a*.) Mathematics applied to Mechanics:
The Applications of Mathematics (as far as the Elements of the Differential and Integral Calculus) to
Kinematics.
Statics of Rigid Solids, Elastic and Perfectly Flexible Bodies, and Perfect Fluids.
Kinetics of a Particle and of Rigid Solids.
The Simpler Portions of Kinetics of Perfect Fluids.

(*b*.) Engineering:
Properties of Materials.—General Properties, with special knowledge of their Strength, and the Purposes to which they are applied, with some knowledge of their Cost.
Strength and Stability of Structures Designed by Civil Engineers.—Metal and Wooden Bridges and Roofs. Arches in Masonry. Walls. Retaining Walls. Embankments. Cuttings. Breakwaters. Aqueducts. Pipes. Canals.
Strength and Forms of the Elements of Machinery.
Design of Combined Structures.—An Elementary knowledge of the Design of Bridges and Roofs, of Reservoirs, Embankments, collecting and distributing Machinery of Waterworks, and of the main features of Railway construction, Harbours, and Drainage.
Design of Machinery.—An Elementary knowledge of the construction of the Steam Engine, stationary and locomotive, of Prime Movers driven by Water, of Mill-wright work, and the general arrangement of Factories.
Prime Movers.—Sources of Power. Estimate of Power required. Measurement of work done. Application of the Principles of Dynamics.

(*c*). Drawing:
The Student must be able to represent neatly, in the style used by Engineers, Plans and Sections of Buildings and Machinery, and also to make Engineering Sketches with Figured dimensions from actual objects.

The candidate who successfully passes the two examinations will be recommended to the Senatus for the Degree.

Doctor of Science Examinations.

1. Every candidate for this Degree must prove that he has passed under a civil engineer in practice. He must then profess one, and not more than one, of the subdivisions in each of the two following groups of subjects:

I. Practical Engineering:
  (*a.*) The design of Machinery, with complete Drawings, Specifications and Estimates.
  (*b.*) The preparation of Designs, Specifications, and Estimates for Civil Engineering work.

II. Applied Science:
  (*a.*) Applied Mathematics.
  (*b.*) Chemistry.
  (*c.*) Geology.
  (*d.*) One Branch of Natural Philosophy.
  (*e.*) Telegraphy.

2. The class of machinery, or the special engineering work on which the student is examined, will be chosen with reference to the special work in which he has been engaged during his pupilage.

3. The Examinations in Group I. will consist in requiring the actual execution of the required work by the student within a month of his receiving the instructions of the Examiners. At the end of that time he will send in his drawings, specifications, estimates, and calculations. When these have been examined and approved, the Student will be required to submit to an oral examination in connection with the work submitted as his own. By this examination the authenticity of the work will be tested.

4. A high degree of proficiency will be required in the special branch chosen by the Student.

J. H. BALFOUR,
ALEX. CRUM BROWN,
Joint Conveners.

SECTION C.—DEGREE OF DOCTOR IN MENTAL SCIENCE.

The Degree of Doctor of Science is also open to Candidates highly prepared in the Mental Sciences.

1. The Candidate must be a Bachelor or Master of Arts, by examination, of a British or recognised Colonial University.

2. He must be a Matriculated Student of this University for the year in which he appears for Examination.

3. He must have attended for at least one Academic year in this University, and during that year he must have taken at least two classes on the subjects embraced in the Examination.

4. The Candidate must, in evidence of literary and philosophical culture, present, at least one month before proceeding to Examination, an original Thesis on a subject in Mental Science approved by the Examiners.

5. The Thesis being accepted, the Candidate may then proceed to an Examination, which shall include Logic and Metaphysics, Moral Philosophy, and the History of Philosophy, both Metaphysical and Moral, in particular on any of the subjects embraced in the following Programme:—

LOGIC AND METAPHYSICS.

(*a.*) *Logic.*—The Province of Logic. Formal Logic.—The Theory and details of Propositional and Syllogistic Forms, with their recent Developments, especially by Hamilton, De Morgan, and Boole. Fallacies. Verbal Logic.—Definition—the Predicables—Nominalism and Realism. Material Logic—The different sorts of Evidence. Authority and Science. The methods of Scientific Induction. The philosophical questions involved in the Theory of Induction.

(*b.*) *Metaphysics.*—Personality.—Classification of the facts of Consciousness, with relative Psychological and Physiological Questions, Externality and External Perception—Matter—Space and Time—Causation and Power. The origin, nature, and limits of Human Knowledge—The finite and the Infinite.

MORAL PHILOSOPHY.

Moral Actions. The Moral Faculty. Desires and Emotions. The Will. Moral Obligation. The Existence and Attributes of God. The relation of Absolute Sovereignty to finite Existence, and especially to human will. The Origin of Evil. The Immortality of the Soul. Practical Ethics, including the laws which regulate the formation of moral character, and the guidance of individual and social life.

HISTORY OF PHILOSOPHY—METAPHYSICAL.

The History of Logic—Formal and Inductive. A general knowledge of the History of Ancient and Modern Psychology and Metaphysics. Special Study of Plato or Aristotle. Special Study of Locke, Berkeley, Hume, and Kant.

HISTORY OF PHILOSOPHY—MORAL.

The relation of the pre-Socratic Philosophy to Moral Philosophy. The Socratic theory as in the *Memorabilia.* The Platonic theory, as in the *Republic.* The Aristotelian, Stoic, and Epicurean Theories. The Theories of Hobbes, Spinoza, Cudworth, Price, Hume, and Kant, with the later developments of Intuitional and Utilitarian Ethics.

6. The examinations will be held annually in April and November. Candidates may be tested both orally and by writing.

7. Those who have taken the Degree of Master of Arts in this University with First-Class Honours in the Department of Mental Philosophy, may obtain the Degree of Doctor in Mental Science when a period of not less than three years shall have elapsed after they have obtained such Honours, by submitting a sufficient Thesis on a subject approved by the Examiners, and on giving such other evidence of continued proficiency in the Mental Sciences as may be satisfactory to the Senatus.

8. The fee for the Degree of Doctor in Medical Science is 7*l.* 7*s.* The fee must be paid at least 10 days before the date of Examination, when the Diploma and Certificates of the Candidate must be transmitted to the Dean of the Faculty of Arts. In the event of the Candidate not passing, the fee is not returned, but he may appear at one subsequent Examination without paying an extra fee, and at any future Examination on paying one half of the fee.

A. C. FRASER,
Dean of Faculty of Arts.

SECTION E.—DEGREE OF DOCTOR OF SCIENCE IN PHILOLOGY.

The Degree of Doctor of Science is also open to Candidates highly proficient in Philology.

1. The Candidate must be a B.A. or M.A. by examination, of a British or recognized Colonial University.

2. He must be a Matriculated Student of this University for the year in which he appears for Examination.

3. He must have attended for at least one Academic year at this University, and during that year he must have taken at least two classes on the subjects embraced in the Examination.

4. The Candidate must present, at least one month before Examination, an Original Dissertation on some point of Philological or Archæological Research. Mere compilations will not be accepted. Only when this Dissertation has been approved of will the candidate be admitted to further examination.

5. The Candidate may offer himself for Examination in any one of the following branches:—

1. The Latin and Greek Languages.
2. The Semitic Languages.

It is expected that Candidates for a Degree in Philology in this branch, besides being acquainted with the Psalms in Hebrew and the Gospels in Syriac, should know the first four Surat or Chapters of the Koran, and be capable of turning sentences of English into Hebrew, Syriac, and Arabic—supplying, at the same time, the proper vowel and diacritical marks. A Dissertation on Semitic Grammar is also deemed necessary.

3. The Sanskrit and Comparative Philology.*
  (*a.*) Sanskrit Language and Literature. Translation of passages from current Sanskrit Authors into English, and from English into Sanskrit.
  (*b.*) Comparative Philology of the Indo-European Languages, Acquaintance with the Principles of the Science, as laid down in the Comparative Grammar of Bopp, Schleicher's "Compendium," and Müller's and Whitney's Lectures."
  (*c.*) Philosophy of Language. Candidates must show some degree of familiarity with the works of Lord Monboddo, "On the Origin and Progress of Language;" Horne Tooke's "Diversions of Purley;" Lersch, "Sprach-philosophie der Alten;" Heyse, "System de Sprachwissenschaft;" Schœmann, "Die Lehre von den Redetheilen;" Steinthal, "Der Ursprung der Sprache."

6. Candidates for the Degree of Doctor of Science in Classical Philology will be tested in respect of their general Scholarship by translation from Latin and Greek Authors, and by composition in Latin and Greek Prose. They will further be required to profess a critical knowledge of some

---

* Dr. John Muir has offered a sum of 100*l.* to the most distinguished candidate who shall first succeed in taking the degree of D.Sc. in the Department of Sanskrit and Comparative Philology.

special Department or Epoch of Classical Literature, or of some three or four of the more difficult and important Classical Writers.

7. The Examinations will be held annually in April and November. Candidates may be tested either orally or by writing.

8. Those who have taken the Degree of Master of Arts in this University, with First Class Honours in the Department of Classical Literature, may obtain the Degree of Doctor of Science in Philology, when a period of not less than three years shall have elapsed after they have obtained such Honours, by submitting a sufficient Thesis on a subject approved by the Examiners, and by such other evidence of continued proficiency in Philological Research as may be satisfactory to the Senatus.

9. The Fee for the Degree of Doctor of Science in Philology is 7*l.* 7*s.* The Fee must be paid at least ten days before the date of Examination, when the Diploma and Certificates must be transmitted to the Dean of the Faculty of Arts. The same regulation as to the non-return of fees applies with reference to this Section as to Section D.

A. C. Fraser,
Dean of Faculty of Arts.

Science Fellowship and Scholarships.

The following Fellowship and Scholarships are open to Graduates in Science:—

1. The *Falconer Memorial Fellowship*, in Palæontology and Geology, of the annual value of about 100*l.*, tenable for two years or more, according to circumstance (*See* under Fellowships, &c.), is open to Graduates in Science or Medicine of this University of not more than three years' standing at the date the Examination. The next competition may take place in October 1876. The present holder of the Fellowship is George Alex. Gibson, B.Sc. of 1874, who obtained the Fellowship in December 1874.

inburgh iversity lendar for 4–75, pp. , 314.

2. The *Baxter Physical Science Scholarship*, tenable for two years, is awarded to the most eminent of the Bachelors of Science who have passed their Examinations in the Physical Sciences, including Experimental Philosophy and Chemistry, either in the year preceding a vacancy or in the year in which a vacancy occurs. The Scholarship is held subject to the condition that the holder shall have taken the Degree of Doctor of Science in the first year of his tenure of it. Annual value, 60*l.* Next appointment may be made in November 1876. The present holder is Robert Romanis, B.Sc., who obtained the Scholarship in November 1874.

3. The *Baxter Natural Science Scholarship*, tenable for two years, is awarded to the most eminent of the Bachelors of Science who have passed their Examinations in the Department of Natural Sciences, including Botany, Zoology, Physiology, and Geology, either in the year preceding a vacancy or in the year in which a vacancy occurs. Annual value, 60*l.* The Scholarship is held subject to the condition that the holder shall have taken the Degree of Doctor of Science in the first year of his tenure of it. The present holder of the Scholarship is Isaac Bayley Balfour, B.Sc., to whom it was awarded in November 1873.

The next competition will take place in November 1875.

Notice as to Science Examinations for 1875–76.

Sections A and B.

1. Preliminary Examinations will take place on Tuesday and Wednesday, 12th and 13th October 1875; and on Tuesday and Wednesday, 14th and 15th March 1876, at 10.30 o'clock A.M.

Examination on Tuesdays.—English, Arithmetic, Mechanics, Higher Mathematics, Greek, German, and other Languages.

Examination on Wednesdays.—Latin, Elements of Mathematics, Natural Philosophy, French, Logic, and Moral Philosophy.

For further particulars as to the Examination in these subjects *see* Medical Preliminary Examination in Arts, in Calendar.

2. First B.Sc. Examination in Mathematics and Natural Philosophy, will take place in April and October, at the same time as the examination in Arts on these subjects, viz., 25th, 26th, and 27th October 1875, and 10th, 11th, and 12th April 1876.

3. First B.Sc. Examination in Chemistry, Botany, and Zoology, will take place in April and October, at the same time as the First Medical Professional Examination, viz., 22nd and 23rd October 1875, and 1st and 3rd April 1876.

4. Second B.Sc. Examinations will take place at the same time as the First Medical Professional Examination.

5. Examinations for D.Sc. will be held in April and October. Candidates must present their Theses at least one month before the date of the Examination.

For B.Sc. in Engineering.

First B. Sc. Examination in Chemistry on the 22nd October 1875, and 1st April 1876, at 11 o'clock.

Examination in Mathematics and Natural Philosopy, on 25th, 26th, and 27th October 1875, and 10th, 11th, and 12th April 1876.

Second B.Sc. in Engineering.

Examination in Engineering and Drawing will take place on 22nd and 23rd October 1875, and 1st and 3rd April 1876.

In Mathematics applied to Mechanics, on 27th October 1875, and 12th April 1876.

Section C.—Public Health.

The Examinations will take place on the 22nd and 23rd October 1875, and 1st and 3rd April 1876, at 12 o'clock each day.

Sections D. and E.

D.Sc. in Mental Science and Philology.

Monday, November 1st, 1875, and following days, as well as Thursday, 13th April 1876, and following days, at 9 o'clock a.m., are fixed for the Examinations of Candidates for the Degree of Doctor in Mental Science and of Doctor in Philology.

Candidates must present their Theses at least one month before the date of the Examination.

II.—Non-Professorial Examiners in the Faculty of Medicine in the University of Edinburgh.

See para. 46.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
March 23, 1875.

Sir,

I am directed by the Duke of Devonshire, the Chairman of this Commission, to state that the Commissioners are desirous of knowing what has recently been done with reference to the Non-Professorial Examiners in the University of Edinburgh, and to ask if you can favour the Commission with any further information on the subject.

I have, &c.
J. Norman Lockyer,
Secretary.

Professor Turner,
University of Edinburgh.

University of Edinburgh,
March 25th, 1875.

Sir,

In reply to your letter of the 23rd inst., in which you ask for further information relative to the Non-Professorial Examiners in this University, I beg to enclose some documents which will, I think, furnish the Duke of Devonshire and the Royal Commission on Scientific Instruction with the information required.

A, gives the terms of the Resolution of the University Court to increase the number of Non-Professorial Examiners from three "to not fewer than seven persons specially "qualified to examine in the subjects of the Medical Exami- "nations."

B, gives the Regulations adopted by the Court relative to the appointment of suitably qualified persons to fill the office of Examiner.

In conformity with these Regulations the Examinerships were advertised in the newspapers, and in the month of January of the present year the University Court selected from a long list of candidates twelve Non-Professorial Examiners, one for each of the subjects embraced in the series of examinations.

The names of the gentleman selected, and the subjects they are appointed to examine on, are given in C.

The Board of Examiners of Candidates for our Degrees in Medicine and Surgery now consists of twenty-four persons, twelve professors and twelve not professors. Each candidate, therefore, will be examined in each subject of examination by two examiners specially qualified for the purpose,—a professor and a non-professor.

Should any further information on this matter be desired by the Duke of Devonshire I shall be happy to supply it.

I may take this opportunity of enclosing for the information of the Commission an extract [D.] from the Minutes of the University Court of date 10th June 1874, being a Resolution to add a Department of Public Health to the Departments in which Degrees in Science may be obtained in this University. The first examination for this Degree was held in October last.

It is believed that the institution of this Degree by the University will supply an important public want.

I have, &c.
Wm. Turner.

J. Norman Lockyer, Esq.

A.

ALTERATION OF ORDINANCE PROVIDING FOR THE APPOINTMENT OF ADDITIONAL (NON-PROFESSORIAL) EXAMINERS IN MEDICINE.

Extract from the Minutes of the University Court of the University of Edinburgh, of date 6th July 1874, being resolution adopting alterations on Ordinance No. 8, Edinburgh No. 3, and Ordinance No. 23, Edinburgh No. 5, providing for the appointment of additional Non-Professorial Examiners in Medicine, and making regulations relative thereto.

"The University Court of the University of Edinburgh, considering that it is desirable that the number of persons who may be appointed to act as medical examiners for graduation in medicine in the University, in addition to the Professors of the Faculty of Medicine, as provided in Ordinance No. 8, Edinburgh No. 3, of the Commissioners appointed for the purposes of the Universities (Scotland) Act, 1858, should be increased, in order that such persons may in future be appointed with a view to their special qualification to examine in one or two of the subjects of the Examinations for Graduation in Medicine on which they may respectively be appointed to examine, rather than with a view to their qualification to examine in such subjects generally,—resolve:

"That the following alteration shall be made on the said Ordinance:

'"SECTION *Quinto* of Ordinance No. 8, *Edinburgh* No. 3, *to be deleted, and the following to be substituted therefor:*

'"SECTION *Quinto*.—That from and after the First day of January, in the year Eighteen hundred and seventy-five, the Medical Examiners for all Candidates for Graduation in Medicine in the said University shall be the Professors in the Faculty of Medicine therein, and in addition not fewer than seven persons specially qualified in the manner herein-after described to examine in the subjects of the Medical Examinations. Such persons shall be appointed annually by the University Court, under such Regulations as may be issued by the said Court from time to time, and shall be eligible for re-election. No such person shall hold the office of Examiner in more than two of such subjects at the same time; two or more of them shall not examine on the same subject, and each of them shall be specially qualified in the subject or subjects on which he shall be appointed to examine. Such persons shall be selected from among the members of the three following bodies, namely, the Royal College of Physicians of Edinburgh, the Royal College of Surgeons of Edinburgh, and the Faculty of Physicians and Surgeons of Glasgow, or shall be persons otherwise fully qualified in the judgment of the University Court. Each of such persons shall receive a fee of Fifty pounds for each year, for each subject on which he shall be appointed to act as examiner."

"And further considering that, by the said alteration of Ordinance No. 8, Edinburgh No. 3, instead of three additional Examiners in Medicine, each receiving a sum of One hundred pounds per annum, paid from moneys voted by Parliament for the purpose, under the provisions of Section XLII. of Ordinance No. 23, Edinburgh No. 5, of the said Universities Commissioners, there will in future be in the University not fewer than seven additional Examiners in Medicine specially qualified in the subjects of the Medical Examinations in the manner above set forth: that these subjects are at present thirteen in number: that each of such Examiners will receive a fee of Fifty pounds for each year for each subject on which he shall be appointed to examine: and, consequently, that it is necessary that the said three sums of One hundred pounds each, paid from moneys voted by Parliament for the purpose, should in future be divided into six sums of Fifty pounds each, and that provision should be made for an additional annual sum for payment of the remainder of the said fees of Fifty pounds each: the University Court further resolve:—

"That the following alteration shall be made on the said Ordinance No. 23, Edinburgh No. 5, of the said Universities Commissioners:

'"SECTION XLII. of Ordinance No. 23, Edinburgh No. 5, *to be deleted, and the following to be substituted therefor:—*

'"XLII.—The sum of Fifty pounds, payable to the additional Examiners in Medicine in respect of each of the subjects on which they may be appointed to examine by the University Court, in terms of Section Quinto of Ordinance No. 8, Edinburgh No. 3, as altered by Resolution of the University Court of date 6th July 1874, shall be paid as follows:—The additional Examiners on Anatomy, Physiology, Practice of Medicine, Surgery, Clinical Medicine, and Clinical Surgery, shall be paid out of moneys to be voted by Parliament for the purpose; and the additional Examiners on the other subjects of the Medical Examinations shall be paid from the General University Fund."'

Extracted by
J. CHRISTISON, W.S.,
Edinburgh, 8th July 1874. Secretary.

The alterations of Ordinances Nos. 8 and 23, contained in the above Extract Minute, received the consent of the Chancellor of the University on 20th July 1874; and were approved by Her Majesty by Order in Council dated 6th August 1874.

B.

REGULATIONS RELATIVE to the APPOINTMENT of NON-PROFESSORIAL EXAMINERS in MEDICINE.

Extract from the Minutes of the University Court of the University of Edinburgh, of date 9th November 1874, being regulations for the appointment of the Non-Professorial Examiners in medicine in the University, adopted by the Court under the powers conferred on them by an alteration of Ordinance No. 8, Edinburgh No. 3, approved by Her Majesty by Order in Council on 6th August 1874.

'The University Court considering that by Section Quinto of Ordinance No. 8, Edinburgh No. 3, of the Scottish Universities Commissioners, 1858, as altered by the Court by a resolution of date 6th July 1874, which received the approval of Her Majesty in Council on 6th August 1874, the Court are empowered from and after 1st January 1875 annually to appoint additional examiners specially qualified in the subjects of examination for graduation in medicine, under such regulations as they may from time to time issue regarding matters not provided for in the said Ordinance or alteration thereof; and further, considering that it is advisable that the persons so appointed should, under ordinary circumstances, hold office for a fixed term of years; and that other matters relative to the appointment of such persons should be made the subject of formal regulation.—Resolve:—

"1. That each person appointed under the said Ordinance as altered, to examine on any of the subjects requisite for graduation in medicine, may, under ordinary circumstances, be reappointed annually for five consecutive years, but not more:—Provided always, that on the first occasion, the persons appointed to examine on three of the subjects of examination may be re-appointed annually thereto for three years; those appointed to examine on two of such subjects may be re-appointed annually thereto for four years; those appointed to examine on three of such subjects may be re-appointed annually thereto for five years; those appointed to examine on two of such subjects may be re-appointed annually thereto for six years; and those appointed to examine on three of such subjects may be re-appointed annually thereto for seven years.

"2. It shall be competent for the Court, under special circumstances, to re-appoint any person to examine on any subject or subjects, immediately after he has acted as examiner thereon for five consecutive years, for such further term of years as the Court may determine.

"3. No person shall be appointed to examine on two subjects which are in the same division of the examinations for graduation in medicine.

"4. Persons resident in Edinburgh shall not be expected to give in testimonials on applying for such appointments. In the case of persons resident elsewhere, who may give in testimonials, not more than four testimonials shall be given in for each subject of examination, for appointment to which application is made.

"5. All vacancies shall be advertised in such newspapers and medical journals as the Court may direct, not less than one month before the date at which such vacancies are to be filled up."

Extracted by
J. CHRISTISON, W.S.,
University of Edinburgh, Secretary.
10th November 1874.

C.

LIST OF THE ADDITIONAL EXAMINERS IN MEDICINE, RECENTLY APPOINTED BY THE EDINBURGH UNIVERSITY COURT, UNDER THE SYSTEM INTRODUCED BY THE ALTERATION OF THE ORDINANCES RELATING TO THE MATTER, APPROVED BY HER MAJESTY BY ORDER IN COUNCIL DATED 6TH AUGUST, 1874.

With power of annual re-appointment by the Court for Three years.

Anatomy.—1. John Chiene, M.D., Lecturer on Surgery, Edinburgh, formerly Demonstrator of Anatomy in the University.

Midwifery.—2. Angus McDonald, M.D., Lecturer on Midwifery, Edinburgh.

Clinical Surgery.—3. James Dunsmure, M.D., formerly Surgeon to the Royal Infirmary, and Lecturer on Clinical Surgery, Edinburgh.

With power of annual re-appointment by the Court for Four years.

Botany.—4. Hugh Cleghorn, M.D., Strairthy, St. Andrews, Examiner in Botany to the India Office for the Forestry appointments, and formerly Professor of Botany and Materia Medica, and Botanist to Government, Madras.

Medical Jurisprudence.—5. David Ferrier, M.D., Professor of Forensic Medicine, King's College, London.

With power of annual re-appointment by the Court for Five years.

Chemistry.—6. James Dewar, F.R.S.E., Jacksonian Professor in the University of Cambridge.

Practice of Physic.—7. Dyce Duckworth, M.D., Assistant Physician to St. Bartholomew's Hospital, London.

Natural History.—8. Wm. C. McIntosh, M.D., Murthly, Author of various important original works on Natural History.

With power of annual re-appointment by the Court for Six years.

Pathology.—9. Joseph F. Payne, M.B., B.Sc., Assistant Physician to, and late Demonstrator of Morbid Anatomy at St. Thomas's Hospital, London.

Materia Medica.—10. Thomas R. Fraser, M.D., F.R.S.E., Medical Officer of Health, Mid. Cheshire, formerly Lecturer on Materia Medica, Edinburgh, and Examiner on Materia Medica in the University of London.

With power of annual re-appointment by the Court for Seven years.

Surgery.—11. James Dunsmure, M.D. (See above).

Clinical Medicine.—12. D. R. Haldane, M.D., Lecturer on Practice of Physic and on Clynical Medicine, Edinburgh, Physician to the Royal Infirmary, Edinburgh, and Member of the General Medical Council.

Physiology.—13. Arthur Gamgee, M.D., F.R.SS.L. & E., Professor of Practical Physiology in the Owens College, Manchester, and Examiner on Forensic Medicine to the University of London.

J. Christison,
Secretary to Edinburgh University Court.

D.

EXTRACT FROM THE MINUTES OF THE UNIVERSITY COURT OF DATE 10TH JUNE 1874, BEING RESOLUTION ADDING A DEPARTMENT OF PUBLIC HEALTH TO THE DEPARTMENTS IN WHICH DEGREES IN SCIENCE MAY BE OBTAINED IN THE UNIVERSITY OF EDINBURGH.

The University Court of the University of Edinburgh, considering the great demand which now exists for Medical Officers of Health, and the importance to the public of some means of ascertaining that members of the medical profession have specially studied the subject of Public Health, and having, as required by Section xii. 2, of the Universities (Scotland) Act, 1858, held due communication on the matter with the Senatus Academicus, and communicated it to the General Council of the University for their consideration at their meeting of 21st April last, 1874, Resolve:—

I. That a Department of Public Health shall be added to the Departments in which Degrees in Science may at present be obtained in the University at Edinburgh.

II. Candidates for Graduation in Science in the Department of Public Health must be Graduates in Medicine of a British University, or of such Foreign or Colonial Universities as may be specially recognized by the University Court.

III. Candidates who have not passed an *Annus Medicus* in the University of Edinburgh must, before presenting themselves for examination, have attended as matriculated Students in the University at least two courses of instruction, Scientific or Professional, bearing on the Subjects of the Examinations.

IV. There shall be two Examinations for the Degree of Bachelor of Science in the Department of Public Health. Candidates who have passed the First Examination may proceed to the Second after an interval of five months.

V. Candidates must produce evidence that, either during their Medical Studies, or subsequently, they have attended a course of lectures in which instruction was given on Public Health, and that they have studied Analytical Chemistry practically for three months with a recognized teacher.

VI. The Examinations shall be written, oral, and practical, and shall be conducted by University Examiners selected by the University Court.

VII. The Subjects of the Examinations for the Degree of Bachelor of Science in the Department of Public Health shall be as follows:—

FIRST EXAMINATION.

1. *Chemistry.*
   - Analysis of Air, Detection of Gaseous Emanations and other Impurities in the Atmosphere.
   - Analysis of Waters for Domestic Use, and Determination of the Nature and Amount of their Mineral and Organic Constituents.
   - Detection, Chemical and Microscopical, of Adulterations in Articles of Food and Drink, and in Drugs.
   - Practical Examination, including at least two analytical researches.
2. *Physics.*
   - Hydraulics and Hydrostatics, in reference to Water Supply, Drainage, and Sewerage.
   - Pneumatics, in reference to Warming and Ventilation.
   - Meteorology, and methods of making Meteorological Observations.
   - Mensuration, in reference to the Plans and Sections of Public and Private Buildings, Mines, Waterworks, and Sewers.
3. *Sanitary Law.*
   - Knowledge of the leading Sanitary Acts of Parliament.
4. *Vital Statistics.*
   - Knowledge of statistical methods and data in reference to Population, Births, Marriages, and Deaths.

SECOND EXAMINATION.

1. *Medicine.*
   - Origin, Nature, and Propagation of Epidemic and Contagious Diseases.
   - Prevention of Contagion and Infection.
   - Endemic Diseases, and the Geographical distribution of Disease.
   - Insalubrious Trades.
   - Overcrowding.
   - Epizootics, including pathological changes.
2. *Practical Sanitation.*
   - Duties of a Health Officer in reference to,—
     - Water Supply.
     - Insalubrious Dwellings and Public Buildings.
     - Removal and disposal of Sewage and other Refuse and Impurities.
     - Cemeteries.
     - Nuisances from Manufactories, etc.
     - Bad or Insufficient Supplies of Food.
     - Outbreaks of Zymotic Diseases.
     - Quarantine.
     - Disinfectants and Deodorisers.
     - Construction of permanent and temporary Hospitals.

VIII. Bachelors of Science in the Department of Public Health may, after the lapse of one year, proceed to the Degree of Doctor in the same Department on producing evidence that they have been engaged in Practical Sanitation since they took the said Degree of Bachelor of Science, and on presenting a Thesis on some subject in the Department of Public Health. Every such Thesis must be certified by the Candidate to have been composed by himself, and must be approved of by the Examiners.

IX. The fees for the said Degrees in Science in the Department of Public Health shall be,—

For the first Examination for the Degree of Bachelor	£5	5	0
For the second Examination for the Degree of Bachelor	5	5	0
For the Degree of Doctor	5	5	0
	£15	15	0

Extracted by
J. Christison, W.S.,
Secretary.

Edinburgh, 12*th June* 1874.

Edinburgh, June 15*th*, 1874.—I approve of the Regulations contained in the foregoing Extract Minute, and sanction the same in terms of the Universities (Scotland) Act, 1858, Section xii. 2.

John Inglis,
Chancellor of the University.

See para. 50.

III.—STATEMENT of the total EMOLUMENTS of the PROFESSORS and ASSISTANTS in the UNIVERSITY OF EDINBURGH; and SCHEDULE of LECTURES and LABORATORY INSTRUCTION.

Royal Commission on Scientific Instruction and the Advancement of Science,
6, Old Palace Yard, London, S.W., May 31st 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to inform you that the Commissioners with a view of making their Report on the Universities of Scotland as complete as possible and, as far as may be, similar in the character of the information it affords, to the Report already issued on the English Colleges, are desirous of including a Statement of the Total Emoluments of the Professors and Assistants in the various Faculties.

With this view, the accompanying Schedules have been drawn up, and I am to ask you to be so good as to further the Inquiries entrusted to the Commission by affording the required information in as complete a form as possible, together with any remarks you may be pleased to make.

I am to add, that as the Report is now nearly ready for presentation to Her Majesty, the Commissioners would be glad to receive the Schedules at as early a date as practicable.

I have the honour to be, &c.,

J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of Edinburgh.

[The following Returns have been forwarded to the Royal Commissioners by the Principal of the University of Edinburgh.]

I.—SCHEDULE OF PAYMENTS.

Chair.	Endowment.	Actual Fees received in 1874-75.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.	REMARKS.
I.—FACULTY OF ARTS.						
	£ s. d.	£ s. d.	£ s. d.		£	
1. HUMANITY (OR LATIN	247 0 0	900 0 0	1,153 0 0	1	100	In addition to the Endowment and Class fees (which were above the average last year), a small addition is made to the total of emoluments, by the fees for one or two examinations. My assistant receives from 80*l.* to 100*l.* more from the fees of two Summer Classes taught by him during the Summer Session.
2. GREEK	About 230*l.*	About 840*l.*	About 1,070*l.*	1	100	——
3. MATHEMATICS	198 6 8	845 15 6	1,044 2 2	1	100	There is about 44*l.* of expenses to be deducted, leaving the clear emoluments at 1,000*l.*
4. LOGIC AND METAPHYSICS.	306 0 0	470 0 0	776 0 0	1	40	Fees in Session 1874–75, above the recent average. Stipend of assistant not sufficient.
5. MORAL PHILOSOPHY.	322 4 4	409 14 0	731 18 4	1	40	The class of session 1874–5 was considerably higher in numbers than any previous class during my term of office.
6. NATURAL PHILOSOPHY.	202 4 4 with about 66*l.* from the recent bequest of Sir D. Baxter.	668 17 0	937 1 4	2	200	The Baxter Endowment is at the disposal of the University Court, which has begun on the principle of giving *less* to a professor in proportion as his class is *larger*.
7. RHETORIC AND ENGLISH LITERATURE.	About 270*l.*; of which 200*l.* from Public Money, and about 70*l.* from Baxter Bequest.	570 0 0	840 0 0	1	40	——

8. PRACTICAL ASTRONOMY.

[With regard to this Chair, the Principal of the University, in a letter dated 3rd July 1875, says:—"I take it upon myself to make the following Return for the Chair of *Practical Astronomy* (no Return having been furnished by the present Professor of this subject):—

"Endowments:

Parliamentary Vote	£300
Sir David Baxter's Bequest (about)	20
Fees	—
Total emoluments (say)	£320

"Lectures: Winter, 0. Summer, 0.

"The Professor is also Astronomer Royal [for Scotland], and receives, in that capacity, 100*l.* per annum additional to his former salary, by a separate Parliamentary Vote. He states that his duties at the Observatory do not admit of his giving regular Courses of Lectures in the University. He offers to *advise and assist* such Matriculated Students as may apply to him with a view to Instruction in Practical Astronomy (see his Statement in *Edinburgh University Calendar* for 1875–76, p. 76). The Chair, however, was founded expressly with an educational object in view, and the University Court have lately had a good deal of correspondence with Professor Piazzi Smyth, as to the possibility of his fulfilling the intentions of the Royal Founder of his Chair, by giving Instruction in Practical Astronomy. Should your Commission desire further information on this subject, I should be happy to afford it."]

9. AGRICULTURE AND RURAL ECONOMY.	12 10 0 37 10 0 150 0 0 150 0 0 18 0 0 368 0 0 In all.	120 0 0	488 0 0	None	None	None.

Chair.	Endowment.	Actual Fees received in 1874-75.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.	REMARKS.
	£ s. d.	£ s. d.	£ s. d.		£	
10. MUSIC.	(Reid Fund.) For Assistance, Instruments, Museum, Library, &c., of Class room, 300*l.* For Annual Reid Commemoration Concert, 300*l.* Salary of Professor, 420*l.* Also from Baxter Fund, an item of (average) 17*l.* 10*s.*	47 5 0	484 15 0	1 (Organ) 1 (Pianoforte) 1 (Janitor Custos, &c., of Class room). Total, 3.	150	—
11. SANSKRIT AND COMPARATIVE PHILOLOGY.	—	—	—	—	—	—
12. ENGINEERING (CIVIL AND MECHANICAL).	400 0 0	220 10 0	620 10 0	1	40 Paid by the University.	My assistant receives further payment from me in consideration of work done for me in my private business. I could not otherwise secure a competent assistant for the pay allowed by the University. The fees are received for three classes. The emoluments are not wholly profits, as some small expenses necessarily fall on the Professor; but these expenses are small.
13. GEOLOGY AND MINERALOGY.	200*l.*, and 200*l.* from annual Parliamentary Vote.	120 0 0	520 0 0	None	—	A sum of about 40*l.* annually was provided by the Founder of the Chair for class expenses.
14. COMMERCIAL AND POLITICAL ECONOMY AND MERCANTILE LAW.	450 0 0	126 0 0	576 0 0	None	None	This Chair was founded and endowed by the Edinburgh Merchants' Company. They pay annually 24*l.* for prizes and 50*l.* for class expenses, including class library, purchase of diagrams, &c., &c.

II.—FACULTY OF THEOLOGY.

	£ s. d.	£ s. d.	£ s. d.		£	
1. DIVINITY.	447 2 2	119 14 0	566 16 2	None.	None.	The sum under the head of "Endowment" is that given in the University Calendar, as I have no other means of knowing, owing to Professor Crawford's absence. The amount of *Fees* is that received from 57 students, at two guineas each. There were other *five*, but these, according to the Professor's instructions, were admitted to the class without a fee.
2. DIVINITY AND CHURCH HISTORY.	350 0 0	79 16 0	429 16 0	—	—	—
3. BIBLICAL CRITICISM AND BIBLICAL ANTIQUITIES.	629 0 0	63 0 0	692 0 0	—	—	There were 42 students, of whom 12 received free tickets. The fee is 2*l.* 2*s.* The income is rapidly and steadily diminishing, as it is drawn from the teinds of the Chapel Royal, and parish ministers in 14 parishes have a right to augmentation of stipend from these teinds. Each has a right every 20 years.
4. HEBREW AND ORIENTAL LANGUAGES.	300 0 0	71 8 0	371 8 0 *2 2 0 373 10 0	Had an assistant for three weeks for the first time in 27 sessions.	—	* Add for two Students of Elementary Hebrew.

Chair.	Endowment.	Actual Fees received in 1874–75.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.	REMARKS.
III.—FACULTY OF LAW.						
	£ s. d.	£ s. d.	£ s. d.		£	
1. CIVIL LAW.	250 0 0	234 3 0	484 3 0	None	- -	Average expenditure of Professor for current foreign literature of Roman Law, about 30*l.* a year; for prizes, in addition to grant (5*l.*) from University chest, 7*l.* 10*s.*
2. LAW OF SCOTLAND.	100 0 0	718 5 0	818 5 0	Two assistants for conduct of examination during both winter and summer sessions.	50	—
3. CONVEYANCING.	105 0 0	457 16 0	562 16 0	4	40	The number of students enrolled was 124. Of these, nine students having already attended two sessions were entitled to free tickets, and free tickets were given to six students who were clerks in the professors' new chambers. The number of students paying fees, therefore, was only 109. The assistants are employed solely in assisting in examining written papers. Their stipend is paid by an annual University grant of 40*l.*, and not by the Professors.
4. PUBLIC LAW AND THE LAW OF NATURE AND NATIONS.	250 0 0	37 16 0	Averages about 300*l.*	- - -	- - -	The Chair is not, and could not under any circumstances be made self-supporting with the present endowment. It has consequently to be maintained by the Professor, in place of the Professor being maintained by it.
5. CONSTITUTIONAL LAW AND HISTORY.	Annually, 150*l.* paid by Exchequer. There is also a share of the Baxter Endowment, estimated at 20*l.*	44 0 0	214 4 0	—	—	—
6. MEDICAL JURISPRUDENCE.	[See under 11.	FACULTY OF MEDICINE.]		—	—	—
IV.—FACULTY OF MEDICINE.						
	£ s. d.	£ s. d.	£ s. d.		£	
1. ANATOMY	None Deduct expenses.	2,000 0 0 395 0 0 1,605 0 0	1,605 0 0	3 Demonstrators 2 Assistant Demonstrators 1 Mechanical Assistant 1 Porter 1 Charwoman Other expenses of Chair. Total	505 180 685	To meet the annual expenses of the Chair of Anatomy, 290*l.* is allowed to the Professor from the General Fund of the University; the balance of 395*l.* is paid by the Professor out of the fees. The total emoluments of the Chair, as derived from fees, are reduced, therefore, by this sum of 395*l.*
2. CHEMISTRY	200 0 0	1,416 9 0	1,616 9 0 Out of this sum the Professor considers it right to devote for class expenses about 430*l.* per annum, allotted as follows:—Additional salary to assistants, 100*l.*; wages to servants, 164*l.* For apparatus and substances used in the laboratory (in addition to 100*l.* granted from the University Fund for this purpose), 165*l.*†	2*	200 from University Fund. 100 contributed by the Professor. 300	* Besides the two regular assistants, a Senior Student receives a scholarship of about 30*l.* per annum, tenable for one year, on condition that he assists in teaching the junior students in the Laboratory. † This sum varies from year to year. 165*l.* is the sum spent this year.
3. MATERIA MEDICA.	100 a year	*674 0 0	774 0 0	1	50	When the Professor commences classes for the practical instruction of students in the New College Buildings, he will require the services of a highly qualified assistant, a junior assistant, and a laboratory servant, the salaries of whom can scarcely be less than 250*l.* It is submitted that these salaries should be paid from the General University Fund, or some special endowment; for the annual charges for other objects in teaching practically, will be so large as to absorb a large proportion of the fees which the University may sanction. * The average fees for some years past have been under 600*l.*

Chair.	Endowment.	Actual Fees received in 1874–75.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.	Remarks.
	£ s. d.	£ s. d.	£ s. d.		£	
4. INSTITUTES OF MEDICINE OR PHYSIOLOGY.	150*l.* from Commissioners for Professor. 100*l.* from Commissioners for assistant. 50*l.* from University for expenses.	1,052 2 0	1,202 2 0	1 demonstrator	140 (100*l.* from Commissioners. 40*l.* from Professor.)	As the Professor pays from his fees 40*l.* to increase the salary of his assistant, and about 30*l.* to cover working expenses, his net income is 1,132*l.* 2*s.*, as nearly as can be calculated for this year (not yet concluded).
5. PRACTICE OF PHYSIC.	100 0 0 (see note 1, under Remarks.)		Gross of the Chairs from all sources, 566 4 0 No account kept of all deductions, but the Museum for course of Medical Psychology has been formed wholly at the cost of the Professors. See note 2, under Remarks.	Three for the three classes.	50	1. Strictly the sum under "*Endowment*" is the equivalent for the examination fees taken from the Professor when the University was re-organized. At present it may be considered as a salary for doing the work of an examiner for degrees, so *that there is no endowment.* 2. The sums received for the different classes are the gross amounts. The cost of the Medical Psychology Course is borne entirely by the Professor, being a voluntary class.
For Winter Course	- - -	260 0 0				
SHARE OF CHAIR OF CLINICAL MEDICINE: (Winter and Summer Courses): Winter course, 114*l.* Summer, 16*l.* 12*s.*	Nil	130 12 0				
SHARE OF CHAIR OF MEDICAL PSYCHOLOGY AND CLINIC OF MENTAL DISEASES:	Nil	75 12 0				
		466 4 0				
Add "Endowment."	- - -	100 0 0				
		566 4 0				
6. SURGERY -	100 0 0	Winter Class: 541 0 0 Summer* Operative Class: 60 0 0	701 0 0	1 paid assistant	50*l.* paid from University fund.	*Winter Class Surgery.*—I have replied to the queries as put in Schedule. They seem only to refer to the gross amount of fees and endowment, but there are many expenses connected with carrying on the class, which should be deducted, probably amounting to 100*l.* for subjects, museum expenses, instruments, apparatus, diagrams, &c. * *Summer Class Operative Surgery.*—The sum of 60*l.* mentioned under the above head, is the gross amount of fees. But as it is necessary to limit the number of pupils, owing to the state of the present University accommodation, and as the expenses for material and instruments are very considerable, the fees never remunerate for teaching the class as at present conducted.
7. MIDWIFERY AND THE DISEASES OF WOMEN AND CHILDREN.	100 0 0 Equivalent for examining fees.	Winter session: 366 9 0 Summer session: 56 14 0 Fees for clinical teaching: 78 9 0	523 3 0 78 9 0 601 12 0	1	50	—
8. GENERAL PATHOLOGY, INCLUDING MORBID ANATOMY.	100 0 0	612 3 0	712 3 0	1	50	—
9. CLINICAL MEDICINE.	[See under 5: PRACTICE OF PHYSIC; and under 11: MEDICAL JURISPRUDENCE.]					—
10. CLINICAL SURGERY.	100 0 0	689 17 0	789 17 0	—	—	—
11. MEDICAL JURISPRUDENCE.	100 0 0	546 0 0	646 0 0	1	50	The real want as to the Chair of Medical Jurisprudence is a decent emolument for an assistant, who should give his whole time to the Laboratory, and enable students to practise analysis in reference to questions of Medical Jurisprudence; and more especially still, of public health, such as water analysis, &c. It is needless to say that the present pay of the assistant is incompatible with this.
Share of Chair of Clinical Medicine.	—	131 0 0	131 0 0	The house physician of the hospital.	None.	

Chair.	Endowment.	Actual Fees received in 1874–75.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.	REMARKS.
	£ s. d.	£ s. d.	£ s. d.		£	
12. BOTANY	200 0 0	1,270 0 0	1,470 0 0	Four, besides the Curator of the Botanic Gardens and three or four gardeners.	100*l*., of which 50*l*. is paid by the University. Each student pays 5*s*. to the Curator of the Garden; this amounted in 1874 to nearly 90*l*. This fee to the Curator ought to be paid by Government and not by students.	The emoluments of the Chair of Botany vary much. During the last 30 years the number of students has varied from 160 to 354. The fees for the courses are given in an appended printed notice. See ¶.
	¶ First Course, £4 4s. Second Course, £3 3s. Third and subsequent Courses, no Fee. Perpetual Ticket, £6 6*s*. Fee for the Superintendent of the Botanic Garden, payable by every student, 5*s*.					
13. NATURAL HISTORY.	195 15 2⅖	For 1875 1,250 11 0	—	1	30	There is no record of the amount of fees received in 1874; Professor Carus having lectured for Professor Wyville Thomson. This summer Professor Huxley conducts the class. The amount of fees received this summer is exceptionally large, the number of students being greatly in excess of the usual number.
14. MEDICAL PSYCHOLOGY WITH PRACTICAL INSTRUCTION IN MENTAL DISEASES.	[See under 5.	PRACTICE OF PHYSIC.]		—	—	—

See para. 57, t seq.

II.—SCHEDULE OF LECTURES AND LABORATORY INSTRUCTION.

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		REMARKS.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
	I. FACULTY OF ARTS.						
1. HUMANITY.	15* every session, and 4 additional every alternate session.	None.	300 or 380	None.	—	—	* Of these lectures or class meetings for oral examinations, the assistant has five each week. The Professor has thus 10 weekly every session, and 14 every alternate session.
2. GREEK.	Two lectures per week in third or private class; one lecture per week in second class; lectures or compositions in first class occasional; teaching, five hours a week in each class; nine hours per week of tutorial work.	—	About 80; teaching hours, inclusive of lectures, about 300. About 170 of tutorial work.	—	—	—	—
3. MATHEMATICS.	13	5 Tutorial only.	About 280	—	—	—	—
4. LOGIC AND METAPHYSICS.	5	—	105	—	—	—	—

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		Remarks.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
5. MORAL PHILOSOPHY.	5	—	About 95	—	—	—	Of the five lectures per week,— *Three* are formal lectures; *Two* are in the form of oral examinations, and conversational expositions.
6. NATURAL PHILOSOPHY.	5 to ordinary class. 3 to advanced class. Total 8	—	110 64 —— 174	—	23 weeks. 25 hours per week.	12 weeks. 25 hours per week.	Summer lectures (about 60 per annum) have this year, for the first time, been undertaken by the Professor at the urgent request of the Medical Faculty. It is probable that this may become a permanent institution; if so, the short period of each year which the Professor has hitherto been able to devote to original work will be very seriously encroached upon.
7. RHETORIC AND ENGLISH LITERATURE.	5	—	100, or just over.	—	—	—	——
8. PRACTICAL ASTRONOMY.	[See Remarks with regard to this Chair under Schedule of Payments, p. 54.]						
9. AGRICULTURE AND RURAL ECONOMY.	5	None.	90 to 100	None.	None.	None.	None.
10. MUSIC	It has been found, in some years' experience of an Art Professorship, that formal lectures are of far less educational value than individual teaching. Recently, therefore, this class has, separately and individually, received practical and theoretical instruction, and thus the progress of each student is constantly gauged and observed. It is impossible that any course of lectures can make a musician, in the artistic sense of the word. A musical student must himself work, with frequent assistance and examination of his work. The principles of Harmony being, like those of Acoustics, based on laws of nature, Music is in one sense a Science as well as an Art. But the subject comes more strictly under the domain and province of Art, as in the case of other Fine Arts. The sympathy and interest of the greatest musicians have ever been with the artistic rather than with the scientific aspect of this study. Whilst leaning to the former of these aspects, the present teaching of this Chair aims at combining Art with Science, Practice with Theory.		15 hours are given weekly to the class, each student receiving an hour, as examination of prepared work, practical or theoretical.	—	A choral class, consisting of about 150 Matriculated Students, has been established in connexion with the Chair (so far as its being trained and conducted by the Professor as voluntary extra work), entitled "The University Musical Society." This meets in the music class room every week or oftener for practice of vocal music, and as evidence of progress a public concert is given in March.	—	Performances on the class room organ by the Professor are given generally on alternate weeks. To these students are admitted by public notice at the College gate, on presentation of Matriculation ticket. The privilege has also been extended to unmatriculated persons, of whom a certain number are admitted on personal written application. The conferring of Degrees in Music is urgently advocated. The University of Edinburgh is the only one possessing a Chair of Music which does not give Bachelors' and Doctors' degrees in that Faculty.
11. SANSKRIT AND COMPARATIVE PHILOLOGY.	—	—	—	—	—	—	——
12. ENGINEERING (CIVIL AND MECHANICAL).	5	5	100	About 12	In a separate class mechanical drawing is taught five days per week for 3 hours each day.	The students at the conclusion of the short course of lectures are taken for six hours each day during 12 days into the field and taught surveying, levelling, and setting out.	There are three classes conducted by the Professor and his Assistant— 1st. The main class, held during the winter session. 2nd. The drawing class, held during the winter session, and chiefly taught by the assistant. 3rd. The summer class of surveying, levelling, and setting out taught by the Professor and his assistant.
13. GEOLOGY AND MINERALOGY.	3	—	60	—	32	—	During the session 1874–75, eight excursions for practical instruction were taken to places of geological interest in the neighbourhood of Edinburgh. At the close of the session, as usual, an excursion of eight days' duration was made. This year the area visited included a traverse of the Highland boundary line from Stonehaven to Aberfoil.
14. COMMERCIAL AND POLITICAL ECONOMY AND MERCANTILE LAW.	5	None.	About 105	None.	None	None	Two lectures are devoted (per week) to Economics; two to Commercial questions; and one, on alternate weeks, to comments on the fortnightly exercises; the other to subjects of interest at the time in commerce or finance. The lectures are interspersed with questions.

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		Remarks.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
II. FACULTY OF THEOLOGY.							
1. Divinity.	10	None.	About 170	None.	None.	None.	There are *two* classes, a junior and senior.
2. Divinity and Church History.	5	—	110	—	—	—	—
3. Biblical Criticism and Biblical Antiquities.	4	—	About 90	—	—	—	From November 11 till the end of March is the divinity session. The lectures were sometimes from MS. and sometimes expositions of a text-book, or of Greek Testament, &c., from notes.
4. Hebrew and Oriental Languages.	Teach 5 days a week.	Teach 2 days a week.	An introductory lecture or two.	None.	None.	None.	—
III. FACULTY OF LAW.							
1. Civil Law.	5	5	90	46	—	—	"Lectures" include examinations, of which there are eight in winter and six in summer. The course is *continuous*, the audience the same, and the fee (5*l.* 5*s.*) covers both sessions.
2. Law of Scotland.	5	5	94 meetings for lecture or examination.	46 meetings for lecture or examination.	—	—	—
3. Conveyancing.	5	None.	90	None.	—	—	82 of the 90 lectures entered were lectures of one hour each. Eight were written examinations of one hour and one half each.
4. Public Law, and the Law of Nature and Nations.	5	—	80 to 90 are given; the number requisite under the Commission being only 40.		—	—	Attended almost exclusively by students for the bar, and the higher class of agents, who have, for the most part, already graduated in Arts, either here or in England.
5. Constitutional Law and History.	—	4 regular and a 5th lecture or examination occasionally	—	40	—		—
6. Medical Jurisprudence.	—	—	—	—	—	—	—
IV.—FACULTY OF MEDICINE.							
1. Anatomy.					Dissecting room open daily from 9 to 4, from Oct. 1st to April 15th.	Dissecting room open daily from 9 to 5, from May 1st to July 30th.	In conjunction with the Systematic Lectures are Tutorial Demonstrations on Osteology, four days a week for three months, from 9 to 10. Also about 20 Demonstrations on Microscopic Anatomy, from 2 to 3.30 p.m. The Professor is engaged during the whole day at the College. The number of Students enrolled in the Class of Anatomy during the incumbency of the present Professor has varied during the Winter Sessions from a minimum of 256 to a maximum of 468, during the Summer Sessions from 75 to 130.
Systematic Lectures.	5	—	100	—			
Demonstrations	4	5	80	40 to 50			
2. Chemistry.	5	3	100	35	Chemical Laboratory open five days per week from 10 a.m. till 4 p.m,	Chemical Laboratory as in winter.	In the Laboratory students are taught chemical analysis, and the making of chemical preparations, and when sufficiently advanced undertake original researches.
Practical Chemistry Class.					During the months of January, February, and March, five hours per week; about 60 hours per session.	Two classes, each 5 hours per week; about 60 hours per session.	The practical chemistry classes are chiefly attended by medical students who have not sufficient time for a full laboratory course.

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		REMARKS.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
3. MATERIA MEDICA.	5	—	100	—	None practicable, except by the Professor and his Assistant, as there is no accommodation for Students. But an extensive Laboratory, for the practical instruction of Students, forms part of the plan of the new College buildings. This instruction will be given probably in summer.		—
4. INSTITUTES OF MEDICINE OR PHYSIOLOGY.	5	None.	100	None.	Two classes of practical physiology, Each class meeting for one hour thrice a week during five months. Also general laboratory instruction in practical physiology.	Four classes of practical physiology. Each class meeting for one hour five times a week during three months. Also general laboratory instruction in practical physiology.	—
5. PRACTICE OF PHYSIC.	5 and 1 tutorial examination.	—	100	—	One hour three days a week.	Ibid.	1. Practical instruction at the bedside is meant under head Laboratory Work. 2. Besides work, as stated, the Professor has to examine all the written and oral examinations for the pass for degrees in Medicine, and to examine continuously for above six weeks in Clinical Medicine during the summer session.
6. SURGERY.	5 lectures per week. Also occasional meetings and examinations on Saturdays.	Practical class for operations, four meetings per week, one each day.	100 lectures at least.	48 or 50 meetings, not formal lectures, practical instruction in operative surgery.	*Class for practical bandaging and surgical appliances. Conducted by my assistant, one hour each day, six days per week.	Operative surgery may be considered as corresponding to laboratory instruction.	* This class consists of sections of the Class of Surgery, and is open to all students of that class without extra fee.
7. MIDWIFERY, AND THE DISEASES OF WOMEN AND CHILDREN.	5	2	98	25	25 hours during the latter half of the session are spent in practical instruction of students by the class assistant.	36 hours of practical instruction by the Professor.	Besides giving the five lectures per week during winter, the Professor meets the class for oral examination each Saturday.
8. GENERAL PATHOLOGY, INCLUDING MORBID ANATOMY.	5	None this summer.	100	None this summer.	Daily.	None this summer.	—
9. CLINICAL MEDICINE.	2	1	25	12	2 hours Clinical teaching daily.	2 hours Clinical teaching daily.	—
10. CLINICAL SURGERY.	2	2	About 40	About 24	—	—	—
11. MEDICAL JURISPRUDENCE AND POLICE, *i.e.* PUBLIC HEALTH.	—	5	—	60	The laboratory is open all the year for students to work in at voluntary work.		—
Chair of Clinical Medicine.	2	2	40	25	The daily work at the hospital, four days a week, may be regarded as the laboratory work in reference to Clinica medicine.		

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		REMARKS.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
12. BOTANY.	Occasional course of popular lectures amounting to 30 or 40.	Lectures 5, of 1 hour each. Demonstrations 3, of 1 hour each. Weekly excursions on Saturdays with demonstration. Time occupied each day from 5 to 10 or 12 hours.	See reply in previous winter column.	Lectures 60 to 65. Demonstrations, 30 to 33. 12 excursions on Saturdays, with demonstrations, from 2nd week of May till last week of July.	Histological room, herbarum room, and museum open for practical work. Garden and houses also open.	Special histological classes conducted by the Professor of Botany and his assistants, four days a week, from 1st May to the end of July.	There is a great want of accommodation for students, both as regards the lecture-room and the practical working room. There is no facility for carrying on proper laboratory work, more especially in the department of physiological botany. Rooms and apparatus are urgently required. The University has supplied 12 microscopes for the class, while I have supplied 60.

Statistics of the Botanical Class for 1874.

Number of pupils, 354; of these 308 were medical students, 9 science students, 4 pharmaceutical students, and 33 general students. Students of first year, 225; advanced students, 129. Pupils of the class of Vegetable Histology, 51.

Number of lectures and examinations, 60; practical demonstrations, 30; histological demonstrations, 20; competitive examinations, 3; excursions, 12.

The following were the excursions:—1. Gorebridge and Arniston. 2. Kinghorn and Burntisland. 3. Currie and Slateford. 4. Dirleton and North Berwick. 5. Broomlee and Dolphinton. 6. Linlithgow. 7. Beattock and Moffat. 8. Springfield and Ladybank. 9. East Linton and Tynninghame. 10. Bridge of Allan and Stirling. 11. Murthly. 12. Inveraran, Ben Voirlich, Loch Lomond.

Number of species of plants collected during the excursions:—Phanerogamous plants, 635; ferns and their allies, 41; other cryptogams, 64. Total, 740.

Number of miles travelled by railway, steamboat, and walking, 961. The number of students who attended the excursions was 228; and the number at each excursion varied from 15 to 132. Total expense of the trips, 3*l.* 7*s.*

Chair.	Lectures per Week.		Lectures per Session.		Laboratory Work.		REMARKS.
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.	
13. NATURAL HISTORY.	—	5	—	From 50 to 60	—	—*	*The laboratory is open daily from 10–4 this summer. Owing to the want of accommodation the number of students attending is limited to 20. Dissection of typical examples of the several groups of the animal kingdom is carried on under the direction of Professor Huxley.
14. MEDICAL PSYCHOLOGY AND CLINIC OF MENTAL DISEASES.	—	4	—	48	—	1 to 2 hours at an asylum weekly.	—

See paras. 52-4.

IV.—NUMBER of STUDENTS attending the several COURSES in the UNIVERSITY OF EDINBURGH.

Royal Commission on Scientific Instruction
and Advancement of Science,
6, Old Palace Yard, London, S.W.
May 11th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to favour the Commissioners by stating the numbers of Matriculated Students at the University of Edinburgh in 1871–72, 1872–3, 1873–4.

Also the numbers studying in the Medical and Engineering Schools in each year from 1867–68 to 1873–74, both inclusive.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of Edinburgh.

University of Edinburgh,
May 14th, 1875.

SIR,

IN reply to your letter dated 11th instant, I have the honour to forward the annexed table containing the statistics required by his Grace the Duke of Devonshire.

I have, &c.
A. GRANT,
Principal.

J. Norman Lockyer, Esq.

NUMBERS of Students Matriculated at the University of Edinburgh for the years 1871–72, 1872–73, and 1873–74.

1871–72	1,854
1872–73	1,906
1873–74	1,930

NUMBERS of Medical Students in the University of Edinburgh in each year from 1867–68 to 1873–74, both years inclusive, and numbers attending the Class of Engineering in said University in each year since 1868, being the date of Foundation of the Chair, to 1873–74, both years inclusive.

Year.	No. of Medical Students.	No. of Engineering Students.
1867–68	445	—
1868–69	516	29
1869–70	586	47
1870–71	678	55
1871–72	725	45
1872–73	782	52
1873–74	839	50

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
April 17th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to favour the Commisioners with a Statement of the number of Students attending the University Course during the past Session in the different Faculties of the University of Edinburgh. The Commissioners are desirous of having as detailed a Statement as possible.

I have, &c.
The Principal of J. NORMAN LOCKYER,
The University of Edinburgh. Secretary.

University of Edinburgh,
SIR, 22nd April, 1875.

IN compliance with the request contained in your letter, dated 17th instant, I have the honour to state the following particulars for the information of His Grace the Duke of Devonshire and the Commissioners on Scientific Instruction:—

The Winter Session 1874–75 in the University of Edinburgh was closed yesterday. During the Session the number of Students attending the University Course in the different Faculties has been has follows:

1. In the Faculty of Arts - -	778
2. In the Faculty of Medicine - -	743
3. In the Faculty of Law - -	310
4. In the Faculty of Divinity - -	66
	1897

The Summer Session of the University will open on the 3rd May, when an additional number of Students will join the University. During the last three years the numbers of Students newly joining the different Faculties of the University in the Summer Session have been as follows:

Summer Session.	Faculties of			Total.
	Medicine.	Arts.	Law.	
1872	89	8	9	106
1873	117	6	7	130
1874	128	8	8	144
Totals	334	22	24	380
Average	111	7	8	126

Owing to the fact that Professor Huxley is to lecture on Natural History in this University during the ensuing Summer Session, it is expected that the number of new Students will be above the average. But, taking merely the average, the number of Students attending the University of Edinburgh during the Academical Year 1874–75 may be set down as,

During Winter Session (actual) - -	1897
During Summer Section (estimate) - -	126
Total	2023

I have, &c.
J. Norman Lockyer, Esq., A. GRANT,
Commission on Scientific Instruction. Principal.

---

e para. 55. V.—STATEMENT of the FEES payable by Students attending the Courses at the University of Edinburgh.

Royal Commission on Scientific Instruction
and the Advancement of Science.
6, Old Palace Yard, S.W.,
SIR, April 28th, 1875.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commissioners, the amount, on an average, of the fees payable by Students per annum at the University of Edinburgh.

I have, &c.
To the Principal of J. NORMAN LOCKYER,
The University of Edinburgh. Secretary.

University of Edinburgh,
SIR, 5th May, 1875.

IN reference to your letter dated 28th April (which absence from Edinburgh has prevented me from replying to sooner), I beg to enclose excerpts from the University Calendar [marked A & B] which show the fees charged for each Class in the different Faculties.

It will be seen that the fee for each Class, or Course of Lectures, in Medicine is four guineas; for each Class in the Faculty of Arts, three guineas, with the exception of Sanskrit, Geology, Agriculture, and Engineering, which are charged four guineas each; for each class in the Faculty of Theology, two guineas; while the fees in the Faculty of Law vary from five to three guineas, according to the length of the respective courses.

I also enclose excerpts (marked C & D) which show the minimum cost of a full Medical Education in the University, and the incidence of that cost on each year of the Student's attendance.

With regard to the Faculties of Arts, Law, and Theology, perhaps, it may be roughly estimated that each Student attends two Classes on an average per annum. I beg, however, to point out, for the information of His Grace the Duke of Devonshire, that the Class fees of Students do not form any contribution towards the expenses of the University, as they go in each case entirely to the Professor who teaches the class.

The Matriculation fees mentioned in excerpt B are the only contribution made by Students towards the University expenses.

Each Student Matriculates, not once for all, but each year while he attends the University, and he pays the Matriculation fee which entitles him during that year to be a "civis" of the University. In the last published accounts of the University's Income the Matriculation Fees are stated for the year as 1,841*l*.

I have, &c.
A. GRANT,
J. Norman Lockyer, Esqre. Principal.

(A.)

Programme of Classes.

SUMMER SESSION.

Classes.	Professors.	Class Fee.	
		£	s.
Engineering, Surveying, Levelling, &c.	Prof. Jenkin - -	3	3
Sanskrit - - -	Prof. Aufrecht -	3	3
Hindustani, &c. - -	Prof. Liston - -	2	2
Civil Law - - -	Prof. Muirhead	5	5*
Scots Law - -	Prof. Macpherson -	5	5*
Constitutional Law and History.	Prof. Mackay - -	3	3
Medical Jurisprudence -	Prof. Maclagan -	4	4
Botany - - -	Prof. Balfour - -	4	4
Botanical Demonstration—Monday, Wednesday, and Friday.	- - -	4	4†
Vegetable Histology—Tuesday and Thursday.	—	—	
Anatomical Demonstration	Prof. Turner.		
Practical Anatomy -	- - -	2	2
Clinical Surgery—Monday and Thursday.	Prof. Lister - -	3	3
Clinical Medicine—Monday and Thursday, Tuesday and Friday.	Prof. Laycock and Prof. Sanders.	3	3
Natural History - -	Prof. Thomson -	4	4
Practical Physiology -	Prof. Rutherford -	3	3
Medical Psychology and Mental Diseases—Monday, Tuesday, and Thursday.	Prof. Laycock -	2	2
Medical Psychology and Mental Diseases with Practical Instruction at an Asylum.	- -	3	3
Operative Surgery -	Prof. Spence - -	2	2
Practical Pathology -	Prof. Sanders - -	2	2

Summer Tutorial Classes in the Faculty of Arts, in Latin, Greek, and Mathematics, will be opened for Students who have attended a Winter Course on these subjects. These Classes will meet five days in each week, commencing on 2nd May, and closing on 21st July. Fee for each Class, 2*l*. 2*s*., payable to the Class Tutor.

---

* Inclusive of Winter Session.
† Besides the Garden fee of 5*s*.

WINTER SESSION.

Faculty of Arts, or Literature and Philosophy.

Classes.	Professors.	Class Fee. £	s.
First Humanity	Prof. Sellar	3	3
Second Humanity	-	3	3
Third Humanity	-	3	3
First Greek	Prof. Blackie	3	3
Second Greek	-	3	3
First Mathematical	Prof. Kelland	3	3
Second Mathematical	-	3	3
Third Mathematical	-	3	3
Logic	Prof. Fraser	3	3
Metaphysics	-	3	3[*]
Moral Philosophy	Prof. Calderwood	3	3
Political Economy—Tuesday and Friday.	Prof. Hodgson	2	2
Natural Philosophy	Prof. Tait	3	3
(Advanced Class)	-	3	3
Rhetoric and English Literature.	Prof. Masson	3	3
Practical Astronomy	Prof. Smyth	3	3
Agriculture	Prof. Wilson	4	4
Sanskrit and Comparative Philology.	Prof. Aufrecht	4	4
Theory of Music	Prof. Oakeley	3	3
Engineering	Prof. Jenkin	4	4
Mechanical Drawing	-	3	3
Geology and Mineralogy	Prof. Geikie.	—	

Faculty of Theology.

Divinity—Junior Class	Prof. Crawford	2	2
Do. Senior Class	—	—	
Divine and Church History	Prof. Stevenson	2	2
Biblical Criticism	Prof. Charteris	2	2
Do. Junior Division.	—	—	
Do. Senior Division. Tuesday and Thursday.	—	—	
Hebrew—Junior Class	Prof. Liston	2	2
Do. and Arabic Advanced Class.	-	2	2
Hindustani[†]	-	2	2
Do.	-	2	2

(B.)

Faculty of Law.

Civil Law	Prof. Muirhead	5	5[‡]
Law of Scotland	Prof. Macpherson	5	5[‡]
Public Law	Prof. Lorimer	3	3
Conveyancing	Prof. Tytler	4	4
Constitutional Law and History.	Prof. Mackay	3	3
Medical Jurisprudence	Prof. Maclagan	4	4

Faculty of Medicine.

Materia Medica	Prof. Christison	4	4
Chemistry	Prof. Crum Brown	4	4
Surgery	Prof. Spence	4	4
Institutes of Medicine	Prof. Rutherford	4	4
Midwifery and Diseases of Women and Children.	Prof. Simpson	4	4
Clinical Surgery—Monday and Thursday.	Prof. Lister	4	4
Clinical Medicine—Monday Thursday, Tuesday, and Friday.	Professors Laycock, Maclagan, and Sanders.	4	4
Anatomy	Prof. Turner	4	4
Natural History	Prof. Thomson	4	4
Practice of Physic	Prof. Laycock	4	4
General Pathology	Prof. Sanders	4	4
Anatomical Demonstrations	Prof. Turner	2	2
Botany	Prof. Balfour.	—	

Royal Infirmary.

Royal Infirmary at Noon, Daily.—Perpetual Ticket, 10*l.*; Annual Ticket, 5*l.* 5*s.*; Half-yearly Ticket, 3*l.* 3*s.* Separate payments of two years entitle the Student to a Perpetual Ticket.

Matriculation Fees.

	£	s.	d.
For the Academical Year	1	0	0
For the Summer Session only	0	10	0

All Students are required to Matriculate at the Registrar's Office, in the University, before entering any of the Classes.

Class Sessions.

There are Two Sessions of the Classes in each year, viz.:—

I. The Summer Session, which opens in the beginning of May and ends with July.

II. The Winter Session, which opens in the beginning of November, and ends with April, during which the Classes in all the four Faculties are assembled.

The order of attendance at the Classes in the Faculty of Arts is referred to in the statement relative to the Curriculum prefixed to the Synopses of the Classes in that Faculty, and is given at length in the Regulations for Graduation in Arts, &c.

In the Faculty of Medicine, besides the Regulations for Graduation, there is a Vidimus of the minimum cost of attendance, with the order of study recommended for Graduation, appended to the Synopses of the Classes in the Faculty of Medicine.

In the Faculties of Law and Divinity, the order of study is given in the Regulations for Graduation in these Faculties, to be found at a subsequent part of the Calendar.

During Summer and Winter, the following means are afforded for Practical Instruction:—

Dissecting Rooms open daily, under the superintendence of Professor Turner, assisted by J. A. Russell, M.B., D. J. Cunningham, M.B., and A. H. Young.

Chemical Laboratories open daily, under the superintendence of the Professor, assisted by E. A. Letts, Ph.D., and A. P. Aitken, D.Sc.

Physiological Laboratory open daily, under the superintendence of Dr. Rutherford, assisted by Wm. Stirling.

Physical Laboratory, and Medical Jurisprudence Laboratory, open daily from 10 to 3, under superintendence of Professors Tait and Maclagan.

Royal Botanic Garden, Herbarium, and Museum, open daily, during summer, from 6 a.m. to 6 p.m.

Natural History Museum, in the Museum of Science and Art, Argyll Square, is accessible to the Students attending the Natural History Class.

(C.)

Minimum cost of attending the Medical Classes, with the Order of Study.

Whilst there is no authorised order of study, the usual Course is given below: Preliminary Examination in Arts to be taken in the month of March or October, before entering Medical Classes. By order of the General Medical Council, all Medical Students require to be registered as such within fifteen days after the commencement of the Session. Students are recommended to commence their Medical Studies by attending the Summer Session.

First Summer Session.

	£	s.	d.
Preliminary Examination Fee	0	10	0
Matriculation Fee	0	10	0
Botany (besides garden fee, 5*s.*)	4	4	0
Natural History	4	4	0
	£9	8	0

Second Summer Session.

	£	s.	d.
Botany or Natural History, if not attended previously.			
Practical Chemistry	3	3	0
Examination in Botany, Natural History, and Chemistry, in October following	5	5	0
	£8	8	0

First Winter Session.

	£	s.	d.
Matriculation (for whole year)	1	0	0
Anatomy	4	4	0
Practical Anatomy	3	3	0
Chemistry	4	4	0
Hospital	5	5	0
(Perpetual Ticket, 10*l.*).			
	£17	16	0

Second Winter Session.

	£	s.	d.
Matriculation	1	0	0
Institutes of Medicine	4	4	0
Surgery	4	4	0
Hospital	5	5	0
Examination in Botany, Natural History, and Chemistry, in April, if not previously passed.			
	£14	13	0

---

[*] Fee, 2*l.* 2*s.* to those who have previously attended the Logic Class.

[†] Two Courses of three months each.

[‡] This includes the Summer Session. Second Year's Course, 3*l.* 3*s.*

(D.)

Third Summer Session.

	£	s.	d.
Practical Pharmacy	2	2	0
Dispensary - -	2	2	0
Hospital.			
	£4	4	0

Third Winter Session.

	£	s.	d.
Matriculation -	1	0	0
Materia Medica -	4	4	0
Pathology - -	4	4	0
Clinical Surgery -	4	4	0
Dispensary - -	1	1	0
Hospital.			
Examination in Anatomy, Physiology, Materia Medica, Pathology in April or July - -	5	5	0
	£19	18	0

Fourth Summer Session.

	£	s.	d.
Medical Jurisprudence - -	4	4	0
Hospital, and Clinical Lectures.			
	£4	4	0

Fourth Winter Session.

	£	s.	d.
Matriculation - -	1	0	0
Practice of Medicine	4	4	0
Midwifery - -	4	4	0
Practical Midwifery	1	4	0
Clinical Medicine -	4	4	0
Vaccination - -	1	1	0
Hospital.			
	£15	17	0

Fifth Summer Session.

	£	s.	d.
Hospital.			
Final Examination for M.B. and C.M.	10	10	0
Total Minimum Expenses for M.B. and C.M. -	104	18	0

Only one Course of Instruction on each subject is here stated, that being the minimum.

Fees for Degrees.

	£	s.	d.
Examination in Botany, Chemistry, Chemical Testing, and Natural History - -	5	5	0
Examination in Anatomy, Physiology, Materia Medica, and Pathology - - -	5	5	0
Final Examination in Surgery, Midwifery, Practice of Physic, Clinical Medicine, Clinical Surgery, Medical Jurisprudence, and Prescriptions, during last Summer Session - -	5	5	0
Total Fees for M.B. Diploma -	15	15	0
Additional Fee for C.M. Diploma - -	5	5	0
Additional Fee for M.D. Diploma - -	5	5	0
Government Stamp-Duty (for M.D. only) -	10	0	0

Note.—Total Fees and Stamp for graduating as M.D only, by Regulations for Students commencing before February 1861, 25*l.*

The Fees for Examinations must be paid eight days before the dates thereof and the Fees for Degrees of C.M. and M.D., and Stamp-Duty for the latter, must be paid on or before the 15th day of July in the year of Graduation.

---

ee para. 63. seq.

VI.—THE PROPOSED NEW BUILDINGS FOR THE UNIVERSITY OF EDINBURGH.

University of Edinburgh,
MY LORD MARQUESS, 23rd March 1875.

I AM requested by Mr. Lyon Playfair to furnish your Lordship with information relative to the proposed New Buildings for the University of Edinburgh.

The particulars are as follows:

The site for the new Medical School and Hall of the University, in immediate proximity to the New Royal Infirmary of Edinburgh, has been purchased for a sum which, with law expenses, amounts to about 33,000*l.* About 1,000*l.*, will have to be paid to redeem a servitude existing over part of the ground.

The Buildings themselves, which are being designed in the plainest style, are roughly estimated to cost 76,000*l.*

The internal fittings are roughly estimated at 20,000*l.*

The total cost of the New Buildings with Architect's fee may then be set down as not less than 135,000*l.*

Besides this expense, about 20,000*l.* will be required for adapting the old Medical Class-rooms in the present College for the use of Professors in Arts, &c.; total 155,000*l.*

Towards this there have been subscribed altogether about 75,200*l.* The subscription field is nearly exhausted, but, perhaps, by great exertions, some 10,000*l.* more may be raised.

I am, &c.
The Most Hon. A. GRANT,
The Marquess of Lansdowne. Principal.

UNIVERSITY OF EDINBURGH BUILDINGS EXTENSION SCHEME.

Appeal for - - -	100,000*l.*
Of which already subscribed -	75,200*l.*

ACTING COMMITTEE.

The Right Hon. the Lord Provost.
Principal Sir Alexander Grant, Bart., LL.D.
Professor Sir Robert Christison, Bart., D.C.L.
James Cowan, Esq., M.P.
E. L. I. Blyth, Esq., C.E.
T. J. Boyd, Esq.
Professor Crum Brown.
John Christison, Esq., W.S.
John Clapperton, Esq.
George Harrison, Esq.
Charles Jenner, Esq.
R. Bruce Johnston, Esq., W.S.
Professor Muirhead.
T. G. Murray, Esq., W.S.
R. M. Smith, Esq.
Professor Tait.
Professor Turner.
Professor Wilson.

Principal Sir Alexander Grant, Bart., Convener.

Samuel Hay, Esq., Union Bank of Scotland, Edinburgh.
James Norwell, Esq., Secretary, Union Bank of Scotland, Edinburgh,
Hon. Treasurers.

Professor Wilson,
John Christison, Esq., W.S.,
R. Bruce Johnston, Esq. W.S.,
Hon. Secretaries.

LONDON COMMITTEE.

The Right Hon. Lyon Playfair, C.B., M.P.
F. Bennoch, Esq., 80, Wood Street, City.
G. M. Birdwood, Esq., M.D., India Museum.
Alexander Halley, Esq., M.D.
H. B. Muir, Esq., 34, Clement's Lane, Lombard Street.
Richard Davy, Esq., F.R.C.S.
Dyce Duckworth, Esq., M.D., 11, Grafton Street, Piccadilly.
F. Churchill, Esq., M.D.
The Rev. Cosmo R. Gordon, D.D.
H. M. Matheson, Esq., 3, Lombard Street.
Macrae Moir, Esq., M.A., Barrister-at-Law.
Charles Murchison, Esq., M.D.
E. H. Sieveking, Esq., M.D.
Philip Vanderbyl, Esq., Cannon Street.
Edward Wyld, Esq., Holland Park.

Dyce Duckworth, Esq., M.D., 11, Grafton Street, Piccadilly,
G. M. Birdwood, Esq., M.D., India Museum,
Hon. Secretaries.

SUMMARY OF PROPOSALS.

1st. To purchase the sites of Park Place and Teviot Row. (This has been already effected at a cost of about 33,000*l.*)

2nd. To erect in the immediate vicinity of the New Royal Infirmary, complete Class-rooms, Theatres, Laboratories, and Museums, with the latest scientific improvements, for the Medical Faculty of the University of Edinburgh.

3rd. To reorganize the existing Class-rooms of the College, and to improve them in direct adaptation to the wants of the several Professors in the Faculties of Arts, Law, and Theology.

4th. To provide increased and more convenient accommodation for the University Library.

5th. To erect an University Hall for the conferring of Degrees, the holding of Examinations, and for all public Academical Ceremonials.

6th. To improve to some extent the north front of the College building.

Statement and Appeal.

One hundred years ago an appeal was made to the public on behalf of the University of Edinburgh. The number of students was then stated as "betwixt six and seven hundred," the inadequacy of the Collegiate buildings to the size and importance of the University was pointed out, and it was declared that while in Edinburgh great improvements were going forward on all hands, "the University fabric alone" remained "in such a neglected state as to be generally counted a dishonour to the city of Edinburgh, and to this part of the Kingdom."

The result of that appeal was a liberal public subscription, opened in March 1768, which, with the aid of Government, provided the handsome edifice now existing. That building for a long period amply sufficed for all the teaching purposes of the University. But the lapse of a century has produced great changes. During that period the population of the Metropolis has been more than trebled; increased facilities for travelling have brought the University within easy reach of all parts of the country; the advantages of an University education have become much more appreciated; the Advancement of Science has widely extended the field of academic teaching; and the renown alike of Teachers and Graduates, whose names will ever be associated with the University of Edinburgh, has increased its fame and reputation throughout the world.

Thus, the buildings of the University again prove to be wholly inadequate to its necessities. The inadequacy is felt in various ways.

The number of Students attending the University in 1768 was "betwixt six and seven hundred," and the number of Professors was 21. In the present session (1874–5) the number of Students is between 1,900 and 2,000, and that of the Professors is 35. The class-room accommadation has thus become wholly insufficient. The Students at present attending the Chemistry, Anatomy, and Natural History Classes number about 300 in each case. The lecture-rooms are consequently much overcrowded, and great personal discomfort is thus occasioned to both the teachers and the taught.

But apart from the present buildings being insufficient as regards the number of students in attendance, the nature of the modern system of teaching in several branches has rendered the existing accommodation altogether unsuitable.

Since the present University buildings were erected, the whole subject of Practical Chemistry has been added to the Course of Study. Within the last 10 years large and commodious Laboratories have been provided in connexion with many of the European Universities, and it would be most unfortunate if the University of Edinburgh, which was the first British School to introduce practical instruction in Chemistry into the medical curriculum, were not enabled to carry on satisfactorily this important branch of medical and scientific training.

Again, the instruction formerly given in Anatomy consisted almost entirely of lectures and demonstrations delivered in the class-room. The changes in medical education during the last 30 years render it necessary that each Student should now pursue for himself the study of Practical Anatomy. The rooms at present in use were not constructed for that purpose, and are lamentably inadequate for the work to be done in them.

But besides the Departments of Chemistry and Anatomy, increased accommodation, in the form of laboratories and rooms suited for microscopic and other practical investigation and instruction, is required for the Chairs of Materia Medica, the Institutes of Medicine, Natural History, and Pathology. Nor is it less urgent that much additional accommodation for the apparatus and the physical laboratory of the Chair of Natural Philosophy should be provided.

There have been recently instituted in the University of Edinburgh, by the liberality of the late Sir David Baxter, of the Merchant Company of Edinburgh, and of the late Sir Roderick Murchison, Chairs of Engineering, Political Economy, and Geology respectively; and by the munificence of Mr. H. G. Watson and Miss Watson, arrangements have been made for establishing a Chair of Fine Art in honour of the late Sir John Watson Gordon, their brother. For none of the classes thus created is there suitable accommodation within the present University buildings, and should the much-needed additional Chairs of Universal History, of Modern Languages, &c., be hereafter erected, the absolute insufficiency of the present class-rooms would of course be increasingly felt.

Collateral with the want of teaching accommodation there is also the disadvantage of restriction upon the natural growth of the Museums of the University. That of Anatomy, for instance, has by the accumulations of years so outgrown the space allotted to it that the Students cannot be freely admitted, and it is to a great extent rendered unavailable for teaching purposes.

The University Library, which yearly accumulates a large number of valuable books, and which is continually receiving, by gift and otherwise, accessions of literary treasures, is fast outgrowing the limits assigned to it.

Nor is it only in its teaching and scientific operations that the University is hampered by the present inadequacy of its buildings. All who are interested in the University must feel it to be unfortunate, if not discreditable, that it possesses no Hall of Assembly in which Degrees may be conferred, the University Council convened, and the installations of Chancellors and Rectors and other academical ceremonies conducted. It is not only inconvenient but also unworthy of the Metropolitan University to be constrained to hire the Music Hall or other common Assembly-Room for such purposes, whilst other Universities possess handsome halls. That about to be erected in Glasgow is estimated at a cost of not less than 55,000*l.*

On the occasion of the late Scott centenary banquet (9th August 1871), the Earl of Dalhousie made a spirited appeal to supply, in connexion with the name of Sir Walter Scott, this great want of the University of Edinburgh. A subscription for a "Scott Hall" was opened, and had good prospect of success; but the committee in charge thought it right to advise its discontinuance for the time, lest it should be found to interfere with that which must be a paramount object with all well-wishers to the University—namely, the provision of more suitable accommodation for its various educational departments.

It is now resolved to make the most strenuous efforts for effecting the improvements thus indicated as essential.

After a full consideration of all the circumstances, it has been concluded that the best arrangement will be to devote the existing University buildings to the service of the Faculties of Arts, Divinity, and Law, and to transfer the Medical School to a new building which will at once afford sufficient accommodation for Lecture-rooms, Museums, Laboratories, and other apartments for practical work.

The site in view, which contains an area of 80,000 square feet, is that occupied by Park Place and a portion of Teviot Row adjacent to the New Royal Infirmary in course of erection. The new buildings will be such as to enable the University to reorganize, not only the Departments of Anatomy and Chemistry, but all the separate Departments of Medical Teaching, on a scale suited to the present advanced state of Science, and to the numbers of students now attending the classes.

The close proximity of the Infirmary will be a great advantage to the medical students, and the removal of this department from the present University building will liberate for the use of Professors of other Faculties a number of class-rooms, which, together with all the class-rooms of the College, should now be improved in ventilation and in other respects.

If it be desired that the University of Edinburgh should continue to hold its present high position, measures of the nature indicated have now become an absolute necessity; for this University cannot be expected to maintain its reputation if it is excelled by other Universities in the material appliances of teaching.

By the munificent liberality, for the most part, of the west of Scotland, the University of Glasgow has recently been furnished with a complete equipment of academical buildings. The private contributions for this purpose amounted, on 27th April last, to 149,277*l.* 16*s.* 2*d.* Unless this University can now extend its fabric, it will not only be debarred from anticipating that steady increase in the number of its students, which it might otherwise naturally expect, but it is obvious that it may even cease to occupy its present high place among the educational institutions of the country. It need hardly be said that such a result is to be deprecated. The interests and well-being of the city of Edinburgh, and indeed of all Scotland, are closely bound up with those of the Metropolitan University.

On these grounds, and because the University has no funds to meet the emergency which has arisen, it is now determined to renew the appeal which was made so effectually to the public a hundred years ago. The reputation which the University has earned by the teaching of such men as Munro, Dugald Stewart, Black, Chalmers, Gregory, Leslie, Forbes, Hamilton, Goodsir, Syme, and Simpson, and by the education within its walls of such men as Mackintosh, Walter Scott, Charles Bell, Liston, Abercrombie, Brougham, Jeffrey, Horner, and Brewster, has hitherto been most worthily maintained. It is the success of the University which has rendered its building extension necessary, and it is hoped that all those who are interested in a continuance of its fame will liberally respond to this appeal.

It is proposed to make the provision of an University Hall dependent on the amount that may be subscribed being sufficient for all purposes, and the contributions will, in the first instance, be devoted to supplying what has become absolutely necessary for the University as a Teaching and Scientific Institution.

Looking to the probable cost of the admirable site selected, and of the required buildings with their outfit, including incidental expenses, the Committee find it necessary to appeal to the general public for contributions to the extent of not less than 100,000*l.*

The amount received will be applied in such manner as may be determined by the General Committee, or by any Acting Committee to be appointed by them.

It is hoped that Her Majesty's Government, which largely contributed to the splendid new buildings of the University of Glasgow, will not fail to give adequate assistance to private efforts for placing the Metropolitan University of Scotland on such a footing as is necessary to preserve it in its present state of efficiency, and enable it to keep pace with other Universities in the march of improvement.

The foregoing Statement and Appeal were framed during the lifetime of that generous friend of the University, the late Sir David Baxter, Bart., and the Committee were encouraged to venture upon the extensive plan of improvements above indicated by his counsel and co-operation, and by the hope that he would liberally assist in carrying it out. That hope has been amply realized, Sir David having bequeathed the sum of 20,000*l.* for the extension of the buildings of the University, or for the purchase of land to form a site. This circumstance, together with the encouraging public support already promised, has led the Committee to submit the accompanying definite "Summary of Proposals," which also include the improvement of the north front of the existing building.

The scheme embodied in the foregoing statement and appeal was inaugurated at a public meeting held in Edinburgh, on 6th April 1874, at which the Right Hon. the Lord Provost presided, and the speakers were His Grace the Duke of Buccleuch, the Right Hon. Lyon Playfair, M.P., the Right Hon. the Lord Justice-General, Chancellor of the University, Mr. Charles Cowan of Logan House, Mr. Campbell-Swinton of Kimmerghame, Mr. Duncan M'Laren, M.P., the Rev. Dr. Macgregor, Mr. John Marshall, advocate, the Rev. Dr. James Taylor, Provost Swan, Kirkcaldy, and the Right Rev. Bishop Cotterill.

The National importance of the University of Edinburgh, and the strong claims of the scheme for its extension to the support of all who are interested in a continuance of its fame and reputation, were ably demonstrated by the speech of the Right Hon. Lyon Playfair. Copies of a full report of the proceedings at the meeting can be obtained on application to any of the Honorary Secretaries.

APPENDIX IV.

PAPERS RELATING TO THE UNIVERSITY OF GLASGOW.

e para. 88.

I.—PROPOSED REGULATIONS for the SCIENCE DEGREE.

[EXTRACTED from the GLASGOW UNIVERSITY CALENDAR for 1874–75, pp. 85–90.]

Bachelor of Science.

The Senate, with the approval of the University Court, have resolved to take the necessary steps to establish the Degree of Bachelor of Science, with three alternative courses of study. Students will be admitted to examination, provisionally, in November 1875. The Courses of Study in the several Departments will be as follows:—

A. IN BIOLOGICAL SCIENCE—Any four of these five:
1. Chemistry.
2. Anatomy.
3. Physiology.
4. Zoology (including Comparative Anatomy).
5. Botany.

And any four of the Classes in the Arts Curriculum.*

B. IN GEOLOGICAL SCIENCE:
1. Geology.
2. Chemistry.
3. Zoology (including Comparative Anatomy).
4. Higher Natural Philosophy.

And any four of the Classes in the Arts Curriculum; provided always that, in the event of a student taking Geodesy in conjunction with any University Class of not less than 25 lectures, he shall be allowed to dispense with one of the Arts Classes.

C. IN ENGINEERING SCIENCE:
1. Mathematics (1 or 2).
2. Natural Philosophy (1 or 2).
3. Inorganic Chemistry (1).
4. Geology (1).
5. Civil Engineering (2).

And any two of the Classes in the Arts Curriculum except Mathematics and Natural Philosophy: provided always that, in the event of a student taking Geodesy in conjunction with the practical course in Civil Engineering, or any other University Class of not less than 25 lectures, he shall be allowed to dispense with one of the Arts Classes.

The following are the General Regulations proposed for the Degree of Bachelor of Science.

1. The examinations in those subjects which are taken from the Curriculum of Arts shall be the same, and subject to the same regulations, as the examination in those subjects for the Degree of M.A.

2. No student may present himself for examination in any subject without having attended a class on that subject in an University; but students may present themselves for examination in any one or more of the subjects so soon as they have attended the requisite classes. No student shall be admitted to a Degree in Science unless he shall have given attendance in this University during the last two sessions of his course, nor unless he has attended the half at least of his course in this University.

3. No special certificate shall be given to students who have passed examinations in subjects for the Degree in Science, but a certified list of successful candidates shall be published after each examination, and shall be copied into a book kept for the purpose by the Registrar. Both copies of the list shall be signed by the examiners.

4. The fee for the Degree in Science shall be 3*l.* 3*s.*, it being provided that if any candidate shall present himself for examination in the different subjects at different periods, he shall pay 1*l.* 1*s.* in each session in which he is examined, till he has paid 3*l.* 3*s.*

5. Students who commenced their course for a certificate in Engineering Science before Session 1871–72, may be granted a Degree on examination in all the appointed subjects without attendance on any class but those requisite for the Certificate in Engineering Science.

6. Examinations for the Degree of M.A. will not be held as available for the Degree of B.Sc., unless passed by the student as a candidate for that degree; but examinations for the Degree of M.A., passed previously to 1st January 1874, will be accepted for the Degree of B.Sc., on the candidate paying the fees for examination for that degree, over and above any fees he may have paid as a candidate for the Degree of M.A.

7. Honours in the subjects taken from the Faculty of Arts shall be given to Graduates in Science only on the same curriculum and examination as to Graduates in Arts.

A. In session 1875–76, the subjects of examination in the department of Biological Science shall be as follows:—

In Physiology.—A general knowledge of the subject as treated, *e.g.*, in Huxley's *Elementary Manual*, and special knowledge of some part of the subject, to be announced from time to time in the Calendar. The special subject for next year to be the General Functions of the Nervous System, including the Brain and Spinal Cord.

In Anatomy.—A general knowledge of Descriptive Anatomy and Histology, and a more detailed knowledge of certain parts of the subject, to be announced from time to time. The special subjects for next year to be—(1.) The Skeleton. (2.) The Joints. (3.) The Muscles. The Terminology will be that of *Human Anatomy*.

In Zoology and Comparative Anatomy.—A general knowledge of the principles of Zoological Classification, with a more detailed knowledge of certain parts of the subject, to be announced from time to time. The special subjects for next year to be—the Nervous System as a guide to Classification; the Placental Mammalia and the Mollusca.

In Botany.—Morphology (Organography), Physiology, and Systematic Botany; the last restricted to the general principles of classification, and to British Natural Orders. The candidate may be asked to describe plants set before him, and refer them to their proper place in the Vegetable Kingdom. (Text-Book recommended, Henfrey's *Elementary Course of Botany*, Masters' Edition.)

---

* *i. e.*, Attendance for one session on any four of the following seven Classes—viz., Latin, Greek, Logic, Moral Philsophy, English Literature, Mathematics, Natural Philosophy.

In Chemistry.—General Principles of Organic Chemistry; Classification of Organic Substances, and Chemistry of Blood, Bile, and Urine.

B. The subjects of examination in the Department of Geological Science shall be as follows:—

In Chemistry.—The Fundamental Principles of the Science; the Chemistry of Rock Formations and Mineralogy.

In Geology.—Lithology and Stratigraphy; Palæontology, and the conditions on which Climatal Changes depend. As special subjects for next year:—Denudation, atmospheric and marine; the composition and origin of Coal and Ironstone; Marine Currents; the varieties of Igneous Rocks found associated with the Carboniferous Strata in Scotland.

In Zoology.—Principles of Classification, and a more detailed knowledge of certain parts of the subject, to be announced from time to time. The special subjects for next year to be—Climatal Influence on the Distribution of Animals; the Structure and Affinities of the Brachiopoda.

In Natural Philosophy.—Students will be required to show equal proficiency to that which is required for the Degree of M.A.

C. The subjects in the Department of Engineering Science shall be as follows:—

In Mathematics.—The subjects of the Senior Mathematical Class.

In Natural Philosophy.—Thomson and Tait's *Elementary Treatise on Natural Philosophy;* portions of Maxwell or Balfour Stewart on *Heat;* Central Forces. Candidates may profess higher subjects.

In Civil Engineering.—The subjects mentioned in the Calendar at pp. 43 and 44, for the two Courses of the Professor of Engineering.

In Geodesy.—Theory of Geodesical Instruments; Methods of Determining Local Time; Longitudes, Latitudes, and Azimuths; Measurement of Base Lines; Principles of Triangulation; Measurement of Arcs of the Meridian.

In Chemistry.—The Fundamental Principles of the Science; the Chemistry of Iron, Copper, Lead, Tin and Zinc; of Building Materials; of Water and Atmospheric air.

In Geology.—Lithology, Stratigraphy; Geology as applied to Mining, and Geological Surveying.

In Chemistry and Geology the examination may be conducted, in whole or in part, at the discretion of the Examiners, by reference to specimens, or (in Geology) by excursions in the field.

See para. 90.

II.—STATEMENT of the TOTAL EMOLUMENTS of the PROFESSORS and ASSISTANTS in the UNIVERSITY OF GLASGOW; and SCHEDULE of LECTURES and LABORATORY INSTRUCTION.

Royal Commission on Scientific Instruction and the Advancement of Science,
6, Old Palace Yard, London, S.W., May 31st, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to inform you that the Commissioners, with a view of making their Report on the Universities of Scotland as complete as possible, and, as far as may be, similar, in the character of the information it affords, to the Report already issued on the English Colleges, are desirous of including a Statement of the Total Emoluments of the Professors and Assistants in the various Faculties.

With this view, the accompanying Schedules have been drawn up, and I am to ask you to be so good as to further the Inquiries entrusted to the Commission by affording the required information in as complete a form as possible, together with any remarks you may be pleased to make.

I am to add, that, as the Report is now nearly ready for presentation to Her Majesty, the Commissioners would be glad to receive the Schedules at as early a date as practicable.

I have the honour to be, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of Glasgow.

Glasgow University, June 18th, 1875.

SIR,

IN the absence of the Principal, I enclose a statement of the Professors and Assistants in the various Faculties of this University. As the Winter Session closed in April, and only a few of the Classes meet in summer, it has been found impossible, partly owing to the absence of some of the Professors, to make the Return quite complete.

In the second return (Schedules of Lectures, &c.), the numbers given include all Class meetings, whether for lectures strictly so called, or for examinations, or other class work. In some of the Classes, instruction is conveyed almost entirely by means of lectures (examinations being only occasional); in others, the greater part of the time is occupied with the examination, chiefly oral but also in writing, of the Students in certain prescribed tasks. In the Humanity and Greek Classes, for example, three of the four hours of daily meeting are spent in this way, and only one in lectures and probations, delivered by the Professor.

I have the honour to be, &c.,
DUNCAN H. WEIR,
Clerk of Senate.

J. Norman Lockyer, Esq.,
Secretary to the Royal Commission on
Scientific Instruction.

I.—SCHEDULE OF PAYMENTS.

Subjects.	Endowments.	Fees or Share of Fees (Average for 3 Years).	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.
	£ s. d.	£ s. d.	£ s. d.		
Logic and Metaphysics. -	280 11 2	560 0 0	*840 11 2	—	—
Moral Philosophy and Political Economy.	301 2 3	350 0 0	*651 2 3	—	—
Natural Philosophy. -	316 11 3	- -	* -	†An assistant under Ordinance, and a Demonstrator in Experimental Physics.	Salary of Assistant 100*l*.
Greek. -	292 4 6	872 11 0	*1,164 15 6	One assistant -	100*l*.
Humanity. -	289 8 11	1,000 0 0	*1,289 8 11	One assistant -	100*l*. (increased by Professor to 250*l*.).

---

* A residence is attached to these Chairs.

† By the liberality of Mrs. Arnott (widow of the late Dr. Neil Arnott) and of Professor Sir William Thomson, a Demonstratorship in Experimental Physics has just been founded (March 1875), and endowed with a capital sum of 3,000*l*.

Subjects.	Endowments.			Fees or Share of Fees (Average for 3 Years).			Total of Emoluments.			Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators.
	£	s.	d.	£	s.	d.	£	s.	d.		
Mathematics - -	312	0	0	820	0	0	*1,132	0	0	One assistant -	100*l.* (increased by Professor).
Astronomy - - -	300	0	0	3	10	0	*303	10	0	One assistant -	100*l.*
Civil Engineering and Mechanics	475	0	0	179	8	0	654	8	0	One assistant -	50*l.* (paid by Professor).
English Literature - -	200	0	0	380	0	0	580	0	0	—	—
Divinity - - -	438	13	7	118	0	0	*556	13	7	—	—
Oriental Languages -	300	0	0	149	0	0	*449	0	0	—	—
Ecclesiastical History -	341	15	7	77	0	0	*418	15	7	—	—
Biblical Criticism - -	315	0	0	62	0	0	377	0	0	—	—
Law - - -	310	0	0	340	0	0	*650	0	0	—	—
Conveyancing - -	100	0	0	213	0	0	313	0	0	—	—
Medicine - - -	270	0	0	-	-	-	*-	-	-	One assistant -	(Paid by Professor.)
Anatomy - - -	250	0	0	781	13	0	*1,031	13	0	Demonstrator and assistants.	200*l.* for assistants and class expenses.
Natural History - -	210	0	0	230	0	0	440	0	0	One assistant in Geology.	(Paid by Professor.)
Surgery - - -	100	0	0	524	5	0	624	5	0	—	—
Midwifery - - -	100	0	0	215	19	4	315	19	4	—	—
Chemistry - - -	200	0	0	640	0	0	840	0	0	Two assistants -	200*l.*
Botany - - -	230	0	0	300	0	0	530	0	0	—	—
Materia Medica - -	100	0	0	264	11	4	364	11	4	One assistant -	25*l.* (increased by Professor to 46*l.*).
Institutes of Medicine -	150	0	0	-	-	-	-	-	-	†Assistant - -	Paid by Professor.
Forensic Medicine - -	100	0	0	200	0	0	300	0	0	One assistant -	25*l.* (increased by Professor).
Clinical Surgery - -	100	0	0	104	9	6	204	9	6	—	—
Clinical Medicine - -	100	0	0	97	2	6	197	2	6	—	—
Waltonian Lecturer on the Eye.	105	5	0	-	-	-	-	-	-	—	—

* A residence is attached to these Chairs.

† There has been for some years also a Lecturer on Pathology in connexion with this Chair.

II.—SCHEDULE OF LECTURES AND LABORATORY INSTRUCTION.

Subjects.	Lectures per Week.		Lectures per Session.		Laboratory Work.	
	Winter.	Summer.	Winter.	Summer.	Winter.	Summer.
Humanity - - -	20	—	500	—	—	—
Greek - - -	20	—	500	—	—	—
Logic and Metaphysics -	10	—	250	—	—	—
Moral Philosophy and Political Economy.	10	—	250	—	—	—
English Literature - -	5	—	80	—	—	—
Mathematics - -	20	—	500	—	—	—
Natural Philosophy - -	10	—	250	—	Daily from 9 a.m. to 4 p.m.	—
Astronomy - - -	1	—	20	—	—	—
Civil Engineering and Mechanics, &c.	10	—	250	—	Two or more days each week.	—
Divinity - - -	5	—	125	—	—	—
Oriental Languages - -	15	—	375	—	—	—
Church History - -	5	—	125	—	—	—
Biblical Criticism - -	5	—	125	—	—	—
Law - - -	9	—	225	—	—	—
Conveyancing - -	5	—	125	—	—	—
Anatomy - - -	15	7	300	—	Daily from 9 a.m. to 4 p.m.	Daily from 7 a.m. to 2 p.m.
Chemistry - - -	10	—	250	—	Daily from 10 a.m. to 4 p.m.	Daily from 10 a.m. to 4 p.m.
Botany - - -	—	5	—	60	—	Demonstration at the Botanic Garden, one hour daily.
Physiology - - -	5	3	125	40	—	—
Natural History - -	5	5	60	60	—	—
Surgery - - -	5	3	110	40	—	—
Materia Medica - -	5	3	110	40	—	—
Practice of Medicine - -	8	2	176	—	—	—
Forensic Medicine - -	5	—	110	—	—	—
Midwifery - - -	5	—	110	—	—	—
Clinical Surgery - -	2	2	50	25	—	—
Clinical Medicine - -	2	2	50	25	—	—

See para. 92.

III.—NUMBER of STUDENTS at the UNIVERSITY OF GLASGOW.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
April 17th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to favour the Commissioners with a Statement of the number of Students attending the University Course during the past session in the different Faculties of the University of Glasgow. The Commissioners are desirous of having as detailed a Statement as possible.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of Glasgow.

Glasgow University,
22nd April 1875.

SIR,

I AM instructed by the Principal of this University to inform you that the number of Matriculated Students attending the University during the past Session was 1,456, viz.:—

In the Faculty of Arts - - -	904
In the Faculty of Medicine - -	339
In the Faculty of Law - - -	153
In the Faculty of Divinity - -	60
Total - - -	1,456

I am also instructed to forward to you the enclosed copy of the "Class Catalogues" of the University referring to the same Session.

I am, &c.
THOS. MOIR,
Registrar.

To the Secretary,
Royal Commission on
Scientific Instruction, &c.

IV.—FEES payable by STUDENTS at the UNIVERSITY OF GLASGOW.

See para. 93.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, S.W.,
April 28th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commissioners, the amount, on an average, of the fees payable by Students per annum at the University of Glasgow.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

To the Principal of
The University of Glasgow.

University of Glasgow,
May 3rd, 1875.

SIR,

I AM instructed by the Principal to inform you that each Student attending this University pays annually a Matriculation fee of 1*l.*, and also a Class fee to each Professor whose Lectures he takes out. The fee for each Course is 3*l.* 3*s.*, with the following exceptions, viz., Natural Philosophy, Scots Law, Civil Law, Conveyancing, 4*l.* 4*s.* each; Astronomy, 1*l.* 1*s.*; Political Economy, 1*l.* 11*s.* 6*d.*; Metaphysics, 1*l.* 11*s.* 6*d.*

Many of the Students attend two Classes each Session, others a greater number; but some take only one Class.

I am, &c.
THOS. MOIR,
Registrar.

APPENDIX V.

PAPERS RELATING TO THE UNIVERSITY OF ST. ANDREW'S.

See para. 125.

I.—INCOME of the UNIVERSITY OF ST. ANDREW'S.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
April 28th 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commisioners, the amount of the income of the United College of St. Salvator and St. Leonard in the University of St. Andrew's.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of the United
College of St. Salvator
and St. Leonard, University
of St. Andrew's.

St. Andrew's,
30th April 1875.

SIR,

I AM directed by the Principal of the United College in the University of St. Andrew's to acknowledge the receipt of your letter, of date 28th curt., requesting him to state, for the information of the Commission, the amount of the income of the United College of St. Salvator and St. Leonard.

In compliance with said request I have now to mention that the income of the United College available for the salaries and incomes of the Principal and eight Professors in the College, after payment of public and parochial burdens on the college lands, permanent charges and expenses, amounts, on an average of the past three years, to 1,950*l.* 11*s.* 1*d.*

The Professor of Chemistry in the United College does not participate in the above income. He receives a salary of 90*l.* per annum from the proceeds of a bequest by the late Dr. Gray, the net amount of which, after defraying other charges, does not admit of any greater payment being made to the Professor.

I have, &c.
STUART GRACE,
Secretary, United College
of St. Andrew's.

J. Norman Lockyer, Esq.,
Secretary, Royal Commission
on Scientific Instruction and
the Advancement of Science.

St. Andrew's,
6th May 1875.

SIR,

I AM directed by the Principal of St. Mary's College in the University of St. Andrew's, to acknowledge the receipt of your letter of date 28th ult., requesting him to state for the information of the Commission the amount of the income of St. Mary's College.

In compliance with said request, I have now to mention that the Revenue of St. Mary's College available for payment of the Salaries and Incomes of the Principal, the Professor of Divinity and Biblical Criticism, and the Professor of Hebrew in the College, after deduction of public and parochial burdens on the College Lands, permanent charges and expenses, amounts, on an average of the past three years, to 720*l.* 8*s.* 3*d.*

The Professor of Divinity and Church History in St. Mary's College does not participate in the above Income.

I have, &c.
STUART GRACE,
Secretary of St. Mary's
College.

J. Norman Lockyer, Esq.,
Secretary, Royal Commission
on Scientific Instruction and
the Advancement of Science.

II.—STATEMENT of the TOTAL EMOLUMENTS of the PROFESSORS and ASSISTANTS in the UNIVERSITY OF ST. ANDREW'S; and SCHEDULE of LECTURES and LABORATORY INSTRUCTION.

See para. 126.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
May 31st, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to inform you that the Commissioners, with a view of making their Report on the Universities of Scotland as complete as possible, and, as far as may be, similar, in the character of the information it affords, to the Report already issued on the English Colleges, are desirous of including a Statement of the total Emoluments of the Professors and Assistants in the various Faculties.

With this view, the accompanying Schedules have been drawn up, and I am to ask you to be so good as to further the Inquiries entrusted to the Commission by affording the required information in as complete a form as possible, together with any remarks you may be pleased to make.

I am to add, that, as the Report is now nearly ready for presentation to Her Majesty, the Commissioners would be glad to receive the Schedules at as early a date as practicable.

I have the honour to be, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of St. Andrew's.

University, St. Andrew's,
June 10th, 1875.

SIR,

I AM directed to acknowledge the receipt of your letter of the 31st ultimo, addressed to the Principal of the University, and to enclose, for the information of your Commissioners, a "Schedule of the Lectures and Laboratory Instruction," and a "Schedule of Payments," as requested by you.

I have, &c.,
ROBERT WALKER,
Registrar.

J. Norman Lockyer, Esq.,
Secretary to the Commission on
Scientific Instruction.

I.—SCHEDULE of PAYMENTS.

Subjects.	Endowments.		Fees, or Share of Fees.	Total of Emoluments.	Number of Assistants or Demonstrators.	Aggregate Stipend of Assistants and Demonstrators
	From College property.	Parliamentary vote.				
I.—UNITED COLLEGE.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.
Principal	307 10 7	240 0 0	none.	547 10 7	—	—
Humanity Professor	195 4 7	120 0 0	152 5 0	467 9 7	—	—
Greek "	215 4 7	100 0 0	155 8 0	470 12 7	—	—
Mathematics "	206 4 7	109 0 0	155 8 0	470 12 7	1	100 0 0
Logic and English Literature Professor	215 4 7	150 0 0	113 11 6	478 16 1	—	—
Moral Philosophy Professor	215 4 7	150 0 0	64 1 0	429 5 7	—	—
Natural Philosophy "	215 4 7	150 0 0	80 17 0	446 1 7	—	—
Chemistry "	*90 0 0	125 0 0	95 0 6	310 0 6	—	—
Medicine "	194 8 11	100 0 0	None exacted by present Professor	294 8 11	—	—
Natural History "	194 8 11	100 0 0	None exacted by late Professor.	294 8 11	—	—
II.—ST. MARY'S COLLEGE.						
Principal and Systematic Theological Professor.	†218 6 1	243 0 0	40 5 0	501 11 1	—	—
Biblical Criticism Professor	327 9 2	87 0 0	21 17 6	436 6 8	—	—
Ecclesiastical History Professor	nil.	‡422 1 8	23 5 6	445 7 2	—	—
Hebrew Professor	174 12 10	211 1 8	30 19 6	416 14 0	—	

* From Dr. Gray's Mortification. † The Principal of St Mary's College has an official residence.
‡ This includes a share of the revenues of the Deanery of the Chapel Royal, which the University Commission estimated would yield 336*l*. per annum.

II.—SCHEDULE of LECTURES and LABORATORY INSTRUCTION.

Subjects.	Lectures per week.	Lectures per session.	Laboratory work.
I.—UNITED COLLEGE.			
Principal	—	occasional.	—
Humanity Professor	15	345	—
Greek "	15	345	—
Mathematics "	13	299	—
Logic and English Literature Professor.	8	184	—
Moral Philosophy and Political Economy Prof.	7	150	—
Natural Philosophy "	7	168	—
Chemistry Professor	7	161	—
Medicine "	3	69	—
Natural History Professor	5	115	—
II.—ST. MARY'S COLLEGE.			
Principal and Systematic Theology Professor.	9	162	—
Biblical Criticism Professor	5	90	—
Ecclesiastical History "	5	90	—
Hebrew Professor	10	180	—

III.—NUMBER OF STUDENTS attending the UNIVERSITY OF ST. ANDREW'S. ee para. 127.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
April 17th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to favour the Commissioners with a Statement of the number of Students attending the University Course during the past Session in the different Faculties of the University of St. Andrew's. The Commissioners are desirous of having as detailed a Statement as possible.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

The Principal of
The University of St Andrew's.

University, St. Andrew's,
April 22nd, 1875.

SIR,

IN reply to your letter of the 17th inst., I beg to state that the number of Students attending the Classes in the Faculty of Arts during Session 1874–75 has been 118. This Faculty includes the following Classes in Mathematical and Physical Science, viz., Mathematics, Natural Philosophy, and Chemistry. The number attending the Faculty of Theology has been 23.

I enclose a printed list, from which the Commissioners will see the number of Students attending the respective Classes.

I have, &c.
J. C. SHAIRP,
Principal of the United College.

J. Norman Lockyer, Esq.

Number of Matriculated Students (Session 1874–75) at the United College	118
Number of Matriculated Students at St. Mary's College	23
Total at the University	141

[Extracted from Lists for 1874–75.]

IV.—FEES payable by STUDENTS at the UNIVERSITY OF ST. ANDREW'S. See para. 128.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, S.W.,
April 28th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commissioners, the amount, on an average, of the fees payable by Students per annum at the University of St. Andrew's.

I have, &c.
To the Principal of J. NORMAN LOCKYER,
The University of St. Andrew's. Secretary.

University, St. Andrew's,
SIR, May 5th, 1875.

IN reply to your letter of the 28th April, addressed to the Principal, I am directed to inform you that Students attending the United College pay a Matriculation Fee of 1*l.* on entering, and a fee of 3*l.* 3*s.* for each Class they may attend during the Session. Should they attend three Classes, which is the average number, in that case the annual payment made by each Student amounts to 10*l.* 9*s.* In the event of their proceeding to Graduation in Arts a further fee of 1*l.* 1*s.* is payable for each of the three Departments of Examination.

Students of St. Mary's College pay a Matriculation Fee of 1*l.*, and a Fee of 2*l.* 2*s.* for each of the Classes they attend, which is in general three in number.

I am, &c.
Norman Lockyer, Esq., ROBERT WALKER,
London. Registrar.

APPENDIX VI.

PAPERS RELATING TO THE UNIVERSITY OF ABERDEEN.

See para. 148. I. CORRESPONDENCE BETWEEN HER MAJESTY'S COMMISSIONERS AND THE PRINCIPAL OF THE UNIVERSITY OF ABERDEEN.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
SIR, February 17th, 1872.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to acquaint you that Evidence on the subject of Scientific Instruction in the Scottish Universities is now being taken; and I am to ask you if you are desirous that any witnesses should be examined with reference to the Scientific Instruction given in the University of Aberdeen, and the Statement which you have already been so good as to forward to the Commission. In the event of this being the case, I am to request you to be so good as to favour me with the names of the witnesses whom you would propose, and to state if either Wednesday or Friday next week would be convenient for taking the evidence, of which a précis should be at once forwarded, in order that it may be printed and circulated among the Commissioners prior to the day of meeting.

Minutes of Evidence, Vol. II., Appendix V., p 7.

I have, &c.
J. NORMAN LOCKYER,
The Principal of Secretary.
The University of Aberdeen.

University of Aberdeen,
SIR, Feb. 23rd, 1872.

I HAVE communicated the contents of your letter to the Professors of the University.

I regret to say that, at this busy season of the year, it would be extremely inconvenient, if not impossible, for any of them to leave their Academic duties for the purpose of going to London.

At the same time I have to observe, that if a précis of the examination to which, in the event of their going there they would be subjected, or any series of queries, should be sent by the Commission, either to the University or to the Professors separately, any information that is desired will be gladly furnished.

May I venture respectfully to express an earnest hope that if any practical steps for the Advancement of Science should result from the labours of the Commission, the deficiencies in appliances for Scientific Instruction, particularly as to *means of illustration*, which this and other Universities labour under, may be borne in mind.

I have, &c.
(Signed) P. C. CAMPBELL,
J. N. Lockyer, Esq. Principal.

6, Old Palace Yard, London, S.W.,
SIR, March 2nd, 1872.

I HAVE laid your letter of the 23rd of February before this Commission, and I am directed by the Chairman to ask when it would be convenient for any of the Scientific Professors to appear before the Commissioners with a view of giving evidence on the deficiencies in appliances for Scientific Instruction referred to in your letter, as the Commissioners can only Report on what may be given in Evidence before them.

I have, &c.
J. NORMAN LOCKYER,
The Principal of Secretary.
The University of Aberdeen.

University of Aberdeen,
SIR, March 4th, 1872.

I HAVE had the honour to receive your letter of the 2nd inst., and will communicate on the subject of it with the Professors.

I fear, however, that it will scarcely be possible for them formally to come to a decision on it before the next meeting of the Senatus, which is to be on the 9th inst.,—Saturday next.

In the meantime, I should be much obliged by your telling me how long the Commission is to sit, and what is the latest period at which evidence will be received.

I have, &c.,
(Signed) P. C. CAMPBELL,
J. Norman Lockyer, Esq. Principal.

6, Old Palace Yard, London, S.W.,
SIR, March 23rd, 1872.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask whether it would be convenient for any of the Scientific Professors to appear before the Commissioners on either the 12th or 19th of April, for the purpose of giving Evidence on Scientific Instruction in the University of Aberdeen?

I have, &c.
The Principal of J. NORMAN LOCKYER,
The University of Aberdeen. Secretary.

The University, Aberdeen,
SIR, March 28th, 1872.

REFERRING to your letter of the 23rd inst., addressed to the Principal of this University, I trust that I may, in the absence of the Principal from ill health, be permitted to say that I shall lay your letter before the Senatus Academicus at its first meeting on the 5th of April next, after which I shall be able to give you a definite answer.

I am, &c.,
(Signed) WM. MILLIGAN,
The Secretary, Secretary of the University.
Royal Commission on Scientific Instruction.

The University, Aberdeen,
SIR, April 8th, 1872.

REFERRING to your letter to the Principal of this University of date 23rd March 1872, I am instructed by the Senatus Academicus to say that, on consideration of the subject therein referred to, the Senatus is of opinion that it has nothing special to communicate to the Commission.

I am, &c.,
(Signed) WM. MILLIGAN,
The Secretary of Sec. of Senatus.
The Royal Commission on
Scientific Instruction.

II. NUMBER OF STUDENTS attending the UNIVERSITY OF ABERDEEN. See para. 148.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, London, S.W.,
SIR, April 17th, 1875.

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to favour the Commissioners with a Statement of the number of Students attending the University Course during the past Session in the different Faculties of the University of Aberdeen. The Commissioners are desirous of having as detailed a Statement as possible.

I have, &c.
The Principal of J. NORMAN LOCKYER,
The University of Aberdeen. Secretary.

Rosemount, Sidmouth, Devon,
SIR, April 26th, 1875.

IN reply to your letter of 17th inst., I have the honour to state that the number of Students attending the University Courses during the past Session (1874–75) was as follows:—

In the Faculty of Arts		336
" " Divinity		36
" " Law		14
" " Medicine		227
		613
Students in both Arts and Medicine	8	
" in both Divinity and Medicine	2	
	10	10
Total number of Students		603

I regret that absence from home has prevented me from making an earlier reply.

I have, &c.
P. C. CAMPBELL,
Principal of the University
of Aberdeen.

The Secretary of
The Royal Commission
on Scientific Instruction, &c.

---

para. 149. III. FEES payable by STUDENTS at the UNIVERSITY OF ABERDEEN.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, S.W.,
April 28th, 1875.

SIR,

I AM directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commissioners, the amount, on an average, of the fees payable by Students per annum at the University of Aberdeen.

I have, &c.
J. NORMAN LOCKYER,
Secretary.

To the Principal of
The University of Aberdeen.

Rosemount, Sidmouth,
May 1st, 1875.

SIR,

IN answer to your letter of the 28th ult., I beg leave to state that the amount, on the average, of the fees payable by the Students per annum at the University of Aberdeen is as follows:—

	£	s.	d.
In the Faculty of Arts	7	12	0
" " Divinity	5	13	4
" " Law	5	4	0
" " Medicine	12	0	6

These are the average sums paid yearly by the Students following the courses requisite in each Faculty, but as many Students attend more than the requisite number of Classes, their expenditure is in such cases higher than the above.

The fee for each Class or Course of Lectures is generally 3*l*. 3*s*.; for Second Classes and Summer Courses generally 2*l*. 2*s*., in some cases 1*l*. 1*s*. In Anatomy:—Second Course, 3*l*. 3*s*.; Third Course, 1*l*. 1*s*.

The average yearly payment stated above includes in each case the annual Matriculation Fee of 1*l*. (which comprises Library and all incidental expenses), as well as fees to Professors. Additional payments have to be made at Examination for Degrees, in Arts, 3*l*. 3*s*.; in Divinity (B.D.), 3*l*. 3*s*.; in Medicine (M.B.), 15*l*. 15*s*., (C.M.), 5*l*. 5*s*; on promotion from M.B. to M.D., 5*l*. 5*s*., in addition to the stamp duty on Diploma. The Degrees of D.D. and LL.D. are Honorary, and no charge is made for them.

A considerable number of Students in the Medical Faculty attend this University only during the last two years of the Curriculum, having studied at other Medical Schools, and some Students, having no views to Graduation, attend Special Lectures in the Faculties of Arts or of Medicine, paying the usual fees to the Professors whose lectures they attend.

I do not understand it to be the wish of the Commissioners to know the gross Revenue of the University and its Officials, arising from pyaments by the Students. But although your letter does not appear to imply this, I should endeavour to prepare a statement on the subject, if desired, and if you would be so good as to let me know the number of years over which you would wish the average to be taken.

I have, &c.
P. C. CAMPBELL,
Principal of the University
of Aberdeen.

J. Norman Lockyer, Esq., Secretary,
Royal Commission on Scientific Instruction.

APPENDIX VII.

PAPERS RELATING TO THE QUEEN'S UNIVERSITY AND THE QUEEN'S COLLEGES IN IRELAND.

I. EXTRACTS from the CIVIL SERVICE ESTIMATES for the FINANCIAL YEAR 1875–76.

The Queen's University in Ireland.

	£
A.—SALARIES	1,261
B.—EXAMINERS' STIPENDS	1,260
C.—EXAMINERS' EXPENSES	735
D.—MEDALS AND PRIZES	749
E.—INCIDENTALS	268
	£4,273

DETAILS of the above.

A.—SALARIES.	SALARY OF OFFICE.			1875–76.
	Minimum.	Annual Increment.	Maximum.	
	£	£	£	£
Secretary*	500	20	600	600
Assistant Secretary†	150	20	320	290
Clerk‡	90	10	180	170
Clerk of Convocation	–	–	–	100
Writers	–	–	–	40
Office Cleaner§	–	–	–	11
Editing Calendar	–	–	–	50
	Total for Salaries			£1,261

B.—EXAMINERS' STIPENDS:

		£
Three Examiners in Greek, two at 18*l*., one at 20*l*.		56
Ditto	Latin ditto ditto	56
Ditto	Mathematics ditto ditto	56
Ditto	Natural Philosophy, two at 18*l*., one at 20*l*.	56
Five Examiners in History, English Literature, Logic, and Metaphysics, four at 18*l*., one at 20*l*.		92
Three Examiners in Chemistry, two at 18*l*., one at 20*l*.		56
Ditto	Natural History, two at 18*l*. one at 20*l*.	56
Ditto	Modern Languages, two at 18*l*., one at 20*l*.	56
Ditto	Anatomy and Physiology, two at 18*l*., one at 20*l*.	56
Ditto	Civil Engineering, at 20*l*. each	60
Ditto	Law ditto	60
Ditto	Political Economy ditto	60
One Examiner in Medicine		100
Ditto	Surgery	100
Ditto	Midwifery, &c.	75
Ditto	Medical Jurisprudence	75
Ditto	Materia Medica	75
Contingent Examiners		100
Superintendents of Examinations		15
		£1,260

---

* This Officer receives also 300*l*. per Annum as Assistant Examiner in Dublin for the Civil Service Commissioners. Class II., Vote 11.

† This Officer received also 18 guineas in 1874, as Assistant Examiner in Dublin for the Civil Service Commissioners. Class II., Vote 11.

‡ This Officer received also 13 guineas in 1874, as Assistant Examiner in Dublin for the Civil Service Commissioners. Class II., Vote 11.

§ A portion of the Stipend of the Office Cleaner, amounting to 5*l*., is paid by the Civil Service Commissioners. Class II., Vote 11.

D.—Medals and Prizes:	£
16 Medals at 5*l.* 5*s.* for First Class at Degree Examination	84
17 Prizes at 15*l.* and one at 10*l.* for Degree Examinations	265
13 Prizes at 10*l.* for First Class at previous University Examination	130
22 Prizes at 10*l.* and three at 5*l.* for Second Class at Degree Examination	235
7 Prizes at 5*l.* for Second Class at Degree Examination at previous University Examination	35
	£749

E.—Incidental Expenses:	
Advertisements, Senators' Expenses, Extra Attendance at Examinations, at Meetings of the University, and at Meetings of Convocation, and Sundries	£268

The Queen's Colleges, Ireland.

A.—In Aid of the Expenses of Queen's College, Belfast	1,000
B.—In Aid of the Expenses of Queen's College, Cork	1,000
C.—In Aid of the Expenses of Queen's College, Galway	1,000
D.—In Aid of the Augmentation of the Salaries of the Professors of the above-named Colleges	1,176
	£4,176

The Sum of 21,000*l.* per annum is charged upon the Consolidated Fund for Salaries of Professors and Officers, and Allowances for Scholars and Prizes, pursuant to 8 & 9 Vict. c. 66. s. 12.

See para. 210.

II. Number of Students attending the Queen's Colleges in Ireland.

6, Old Palace Yard, London, S.W.
May 12th 1875.

Sir,

I am directed by the Duke of Devonshire, the Chairman of this Commission, to ask you to be so good as to state, for the information of the Commissioners, the number of Students in the several Faculties at Queen's College { Belfast, Cork, Galway, } during the Session 1873–4.

I have, &c.
J. Norman Lockyer,
Secretary.

The President of
Queen's College, Belfast,
„ „ Cork,
„ „ Galway.

Sir, Queen's College, Belfast, May 14th, 1875.

I have the honour of sending to you herewith, in compliance with your communication to me of the 12th inst., a return of the number of Students who attended this College during the Session 1873–74, classified departmentally.

It will be observed by a comparison with my Report for 1872–73, of which I have the honour of sending a copy by post to his Grace the Duke of Devonshire, that in the Session 1873–74 there was an increase of 24 Students here. I also take the liberty of sending to his Grace the Duke of Devonshire a copy of the Report of the Queen's University for 1875.

My Report for the year ending in October last (1874), is nearly printed, and will be presented to Parliament immediately after Whitsuntide.

I am happy to say that during the current Session an increase again appears, as 392 Students are at present in attendance.

I have, &c.
P. Shuldham Henry,
President.

Return of the Number of Students in the several Faculties or Departments at Queen's College, Belfast, during the Session 1873–74.

In Arts	118
„ Civil Engineering	20
„ Law	26
„ Medicine	205
Not pursuing any Special Course or Faculty	13
	382
Attending in two Departments	7
Total number of separate Students	375

(Signed) Rd. Oulton, B.D., Registrar,
May, 1875. Queen's College, Belfast.

Report of the President of Queen's College, Cork, for the Academic Session 1873–74, p.

The Distribution of the Students attending Queen's College, Cork, among the several Faculties, during the Session 1873–74, is shown in the following Table:

—	Matriculated Students.	Non-Matriculated Students.	Total.
Faculty of Arts	58	6	64
„ Law	7	—	7
„ Medicine	154	16	170
„ Engineering	19	—	19
Total	238	22	260*

* Of this number, 10 Students entered for, and attended Lectures in, two Faculties.

Sir, Queen's College, Galway, May 14th, 1875.

I beg to send you, for the information of his Grace the Duke of Devonshire and the Commissioners of Scientific Instruction, the number of Students in the several Faculties at the Queen's College, Galway, during the Session 1873–74.

I have, &c.,
Edward Berwick, President.

Return showing the Number of Students in the several Faculties at Queen's College, Galway, during the Session 1873–74.

—	Members of the Church of Ireland.	Presbyterians.	Roman Catholics.	Other Denominations.	Total.
Faculty of Arts	7	21	26	1	55
„ Law	1	3	5	—	9
„ Medicine	21	15	43	4	83
Department of Engineering	6	2	2	—	10
Occasional Students	—	1	1	—	2
Non-Matriculated	2	—	3	1	6
Totals	37	42	80	6	165
Of these nine attended in two Faculties, viz :—	2	4	3	—	9
Total of separate individuals.	35	38	77	6	156

Queen's College, Galway, Edward Berwick,
May 14th, 1875. President.

See para. 21

Number of Students (Matriculated and Non Matriculated) attending the Queen's Colleges in Ireland, in the Session 1874–5.

[Received in reply to telegrams.]

—	Matriculated.	Non-Matriculated.	Total.
Belfast	345	47	392
Cork	226	23	249
Galway	148	6	154

LONDON:
Printed by George E. Eyre and William Spottiswoode,
Printers to the Queen's Most Excellent Majesty.
For Her Majesty's Stationery Office.

EIGHTH REPORT

OF THE

ROYAL COMMISSION

ON

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1875.

[C.—1298.] *Price 7d.*

CONTENTS.

	Page
COMMISSIONS - - - - - -	iii
REPORT - - - - - -	1
APPENDICES - - - - -	49

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

Victoria, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Right Trusty and Right Entirely Beloved Cousin William Duke of Devonshire, Knight of Our Most Noble Order of the Garter,—Our Right Trusty and Entirely Beloved Cousin Henry Charles Keith Marquess of Lansdowne,—Our Trusty and Wellbeloved Sir John Lubbock, Baronet,—Our Trusty and Wellbeloved Sir James Phillips Kay-Shuttleworth, Baronet,—Our Trusty and Wellbeloved Bernhard Samuelson, Esquire,—Our Trusty and Wellbeloved William Sharpey, Esquire, Doctor of Medicine,—Our Trusty and Wellbeloved Thomas Henry Huxley, Esquire, Professor of Natural History in the Royal School of Mines,—Our Trusty and Wellbeloved William Allen Miller, Esquire, Doctor of Medicine, Professor of Chemistry in Kings College, London,—and Our Trusty and Wellbeloved George Gabriel Stokes, Esquire, Master of Arts, Lucasian Professor of Mathematics in the University of Cambridge, Greeting:

Whereas We have deemed it expedient for divers good causes and considerations that a Commission should forthwith issue to make Inquiry with regard to Scientific Instruction and the Advancement of Science and to Inquire what aid thereto is derived from Grants voted by Parliament or from Endowments belonging to the several Universities in Great Britain and Ireland and the Colleges thereof and whether such aid could be rendered in a manner more effectual for the purpose.

Now Know Ye that We reposing great Trust and Confidence in your Ability and Discretion have nominated constituted and appointed and do by these Presents nominate constitute and appoint you the said William, Duke of Devonshire—Henry Charles Keith, Marquess of Lansdowne—Sir John Lubbock—Sir James Phillips Kay-Shuttleworth—Bernhard Samuelson—William Sharpey—Thomas Henry Huxley—William Allen Miller—and George Gabriel Stokes—to be Our Commissioners for the purposes of the said Inquiry.

And for the better enabling you to carry Our Royal Intentions into effect We do by these Presents authorize and empower you or any three or more of you to call before you or any three or more of you such persons as you may judge necessary by whom you may be the better informed of the matters herein submitted for your consideration and also to call for and examine all such Books Documents Papers or Records as you shall judge likely to afford you the fullest information on the subject of this Our Commission and to Inquire of and concerning the Premises by all other lawful ways and means whatsoever.

And Our further Will and Pleasure is that you or any three or more of you do Report to Us under your Hands and Seals (with as little delay as may be consistent with a due discharge of the Duties hereby imposed upon you) your opinion on the several matters herein submitted for your consideration, with power to certify unto Us from time to time your several proceedings in respect of any of the matters aforesaid, if it may seem expedient for you so to do.

And We do further Will and Command and by these Presents ordain that this Our Commission shall continue in full force and virtue and that you Our said Commissioners or any three or more of you shall and may from time to time proceed in the

execution thereof and of every matter and thing therein contained although the same be not continued from time to time by adjournment.

And for your assistance in the execution of these Presents We do hereby authorize and empower you to appoint a Secretary to this Our Commission to attend you whose services and assistance we require you to use from time to time as occasion may require.

Given at Our Court at Saint James's, the Eighteenth day of May 1870, in the Thirty-third year of Our Reign.

By Her Majesty's Command,

H. A. BRUCE.

ROYAL COMMISSION ON SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

VICTORIA R.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland Queen, Defender of the Faith, To Our Trusty and Well-beloved Henry John Stephen Smith, Esquire, Master of Arts, Savilian Professor of Geometry in Our University of Oxford, Greeting:

Whereas We did by Warrant, under Our Royal Sign Manual, bearing date the Eighteenth Day of May, One Thousand Eight Hundred and Seventy, appoint Our Right Trusty and Right Entirely Beloved Cousin, William, Duke of Devonshire, Knight of Our Most Noble Order of the Garter, Our Right Trusty and Entirely Beloved Cousin, Henry Charles Keith, Marquess of Lansdowne, together with the several Gentlemen therein named, to be Our Commissioners to make Inquiry with regard to Scientific Instruction and the Advancement of Science, and to inquire what aid thereto is derived from Grants voted by Parliament, or from Endowments belonging to the several Universities in Great Britain and Ireland, and the Colleges thereof, and whether such aid could be rendered in a manner more effectual for the purpose: And whereas since the issue of the said Warrant William Allen Miller, Doctor of Medicine, one of the Commissioners thereby appointed, hath deceased:

Now Know Ye, that We, reposing great Trust and Confidence in Your Zeal, Discretion, and Integrity, have authorized and appointed, and do by these Presents authorize and appoint you the said Henry John Stephen Smith to be a Commissioner for the purpose aforesaid, in addition to, and together with, the Commissioners now acting under the above-mentioned Royal Warrant.

Given at Our Court at Saint James's the First Day of December 1870, in the Thirty-Fourth Year of Our Reign.

By Her Majesty's Command,
H. A. BRUCE.

Professor Henry John Stephen Smith, M.A.,
To be a Commissioner for inquiring into
Scientific Instruction and the Advancement of Science.

EIGHTH REPORT.

TO THE QUEEN'S MOST EXCELLENT MAJESTY.

May it please Your Majesty,

We, the Commissioners appointed by Your Majesty to make Inquiry with regard to Scientific Instruction and the Advancement of Science, humbly beg leave to present to Your Majesty, in conclusion of the Inquiry entrusted to us, the following Report on the Advancement of Science and on the Relations of Government to Science.

In the course of our Investigations into the Proceedings and Management of the Universities, Colleges, Museums, and other Institutions, which exist wholly or in part for Scientific Purposes, considerations bearing on the Relations of the Government to Science, and on the Advancement of Scientific Research, necessarily came under our notice to a certain extent; they were, consequently, referred to in an incidental manner in the Reports already submitted to Your Majesty, which, however, were mainly concerned with Scientific Instruction. The present Report will address itself directly to the Relations of Government to Science, and to the Advancement of Scientific Research; and our Inquiry divides itself into the following branches:—

(1.) The Scientific Work carried on by Departments of the Government.
(2.) The Assistance at present given by the State towards the promotion of Scientific Research.
(3.) The Assistance which it is desirable the State should give towards that object.
(4.) The Central Organization which is best calculated to enable the Government to determine its action in all questions affecting Science.

I.—The Scientific Work carried on by Departments of the Government.

The principal branches of Scientific Work conducted by Officers of the Imperial Government, and the Departments by which they are administered, are as follows:—

- Topographical Survey [Treasury (Office of Works)].
- Hydrographical Survey [Admiralty].
- Geological Survey [Privy Council].
- Astronomical Observations:
  - Greenwich and the Cape of Good Hope [Admiralty].
  - Edinburgh [Treasury (Office of Works)].
- Meteorological Observations:
  - Greenwich [Admiralty].
  - Edinburgh [Treasury (Office of Works)].
  - The Meteorological Office.

[The Meteorological Office is not administered by any Public Department, but is directed by a Committee, which, although appointed by the Royal Society, is independent of that body.]

- Botany.—Royal Gardens, Kew; Botanic Garden, Edinburgh; Botanic Gardens, Dublin [Treasury (Office of Works)].
- The Chemical Department of the War Office.
- The Standards Department of the Board of Trade.

Analogous work is carried on in some of the Colonies and Foreign Possessions by Departments of their respective Governments.

In one case, that of the Royal Observatory, Greenwich, the work is examined into and reported on to the Admiralty by a Board of Visitors composed of men of Science.

Some branches of the work dealt with, from the accident of their origin and from other causes, are less entirely devoted to the direct necessities of the State than others; whilst it will be seen that there are certain lines of investigation of no less importance to the State than those for which provision has already been made, which the State has not as yet undertaken.

The Imperial Investigations enumerated, with the exception of the very special work of the Chemical Department of the War Office and the Standards Department of the Board of Trade, generally extend over large areas or long periods of time, and consequently are of such a nature that the State could not safely intrust them to the action of Individuals or Societies, even if these were willing to undertake them.

When Scientific questions arise on which the Departments are not supposed to possess the requisite theoretical or practical information, Special Committees are appointed or the advice of individuals presumed to be specially qualified is obtained, either directly or through the Royal, the Geographical, or some other Learned Society.

The following is a Statement showing the annual charges borne by Imperial Funds, at the present time, to defray the expenses of such of these various investigations as appear separately in the Estimates for the year 1874–75.

Appendix I.

	£
Topographical Survey (excluding Military pay of men employed).	132,000
Hydrographical Survey	121,055
Geological Survey	22,920
Astronomy	9,703
Meteorology	12,082
Botany, including the maintenance of Botanical Gardens as places of Public Recreation	21,470
Standards Department of the Board of Trade	2,063

In addition to these recurring charges, sums are voted from time to time for various Expeditions and for Experiments incidental to the Services of the various Departments, such as the Investigations concerning the Causes and Processes of Disease carried on under the Direction of the Lords of the Privy Council, and the various Experimental Researches carried on for the Army and Navy.

We have not considered it necessary to take Evidence regarding the detailed work of the Public Departments, but have thought it sufficient to collect the general opinion of those who are connected with, or well-informed concerning, the Scientific Work carried on by those Departments.

In the case of the Meteorological Office, however, both on account of its recent establishment and the circumstance that it is not directly responsible to any Public Department, we have felt it our duty to take Evidence at some length, both as regards its Scientific and Financial Administration.

Evidence as to the Insufficiency of the present Organization.

The Evidence which we have taken as to the sufficiency or insufficiency of the work done for the Advancement of Science, including that of the Government Departments, is very copious. A large portion of it is contained in the volumes already published, and it will have been seen that there is a general concurrence of opinion, that, even in the interests of the Departments themselves, more ought to be done by the Government in the way of Investigation, particularly in respect of those Sciences the Practical Application of which has been developed, or the scope of which has been enlarged by Discovery, within recent years.

These opinions are entertained alike by persons engaged in Scientific Work under the various Departments of the Government, and by Scientific Men having no official connexion with the State.

The following are extracts from the Evidence on this branch of the subject.

Sir Henry Rawlinson, a member of the Indian Council, states that in that Council
Qu. 12,564. they perpetually have references before them which they are unable to deal with. He adds:

> Qu. 12,565. * * * "We have, for instance, Sir William Baker upon the Council, and General Strachey and Colonel Strange both attached to the Office; yet, notwithstanding their valuable aid, there are many subjects referred to us with which we are quite incompetent to deal."

He then refers to the following subjects among others:—The Manufacture of Iron and Steel in India; the Efflorescence of Soda on Irrigated Land; the Fermentation of Beer, "which " may involve a loss of 200,000*l*. or 300,000*l*. a year to the British Government;" the question of Drought arising from the Destruction of Forests; the Construction of Harbours and of other Hydraulic Works; the Founding of Brass Guns; Tidal Observations; the Publication of Works on the Flora and Fauna of India; Geological and Trigonometrical Surveys; Sea Dredging; and Observatories.

He points out that many of these questions are practical and economical, but that still there is a scientific element in almost all of them, and he adds—

> Qu. 12,565. "References on all these subjects are constantly coming home, and we have no means of answering them in our own body, while it is very unsatisfactory to be obliged to send out for gratuitous information. We do sometimes, it is true, apply to individuals and sometimes to societies, but in very many cases, I am afraid, the questions are shelved, because there is no competent and authoritative body to refer to."

Captain Douglas Galton, of the Office of Your Majesty's Works and Public Buildings, thinks that, as a rule:

> Qu. 12,966. * * * * "Our statesmen do not appreciate properly the value of scientific advice or scientific inquiry, and that they are very much fonder of experiments made upon a large scale with no defined system, than they are of experiments which have been brought out as the result of a carefully studied previous inquiry. I think that an enormous amount of money was wasted in the case of the inquiry into armour plates, both for ships and forts. In that case the Government appointed a partly scientific committee, but it was mixed up with other persons who were not scientific; and instead of commencing a series of experiments upon a small and clearly defined scale, from which they could have drawn conclusions for making their larger experiments, they began by firing at any plates that were offered to them which had no relation one to another, either in their relations to the guns or to the form of backing, or in any other way, and consequently it was difficult to draw useful calculations from them."

Mr. Froude, who was a prominent member of the late Committee on Naval Designs, and who is now devoting his whole time without remuneration to the investigation of the proper forms of ships of war, states that if, at an earlier time, a laboratory had existed, and proper experiments had been made, enormous sums would have been saved which have been expended in the actual construction of ships, or, as he terms it, in "experiments on the scale of 12 inches to a foot;" and that definite results would have been arrived at with less loss of time.

> Qu. 11,344. "I think any experiment almost on the sailing or rolling properties of a big ship, when tried in a big ship to begin with, is a waste of money. The cost of construction of a big ship as an instrument of investigation is enormous; and if it is tried with a view to the application of a new principle, there must be the risk that the experiment will be to some extent wasted. Being an experiment, the very fact that it is an experiment implies that it may not turn out as it is expected, and a failure in so costly a piece of apparatus as a new complete ship is inevitably a very costly failure. So far as it is possible to arrive at a proper understanding of such subjects by small-scale trials, it is of the utmost importance, economically, that that method should be adopted, and I think that that has not been sufficiently adopted."

It will be seen from the Evidence of General Strachey, which we quote in a subsequent part of this Report, that he also disapproves of the mode in which Government is at present advised on questions of Science, especially on the ground of the absence of scientific training in the political and official classes of this country.

Sir Wm. Thomson has given us the following Evidence:

> Qu. 10,675. * * * "With a vast amount of mechanical work which is necessarily undertaken by the Government, and which is continually in hand, questions involving scientific difficulties of a novel character frequently occur; questions requiring accurate knowledge of scientific truth hitherto undeveloped are occurring every day. In both respects the Government is at present insufficiently advised, and the result is undoubtedly that mechanical works are sometimes not done as well as they might be done, that great mistakes are sometimes made; and, again, a very serious and perhaps even a more serious evil of the present system, in which there is not sufficient scientific advice for the Government, is the undertaking of works which ought never to be undertaken."
>
> Qu. 10,676. "Are you able to point out any instances which you have in your mind of mistakes which you think have occurred from the want of good advice on the part of the Government?—One great mistake undoubtedly was the construction of the "Captain," and I believe that a permanent scientific council advising the Government would have made it impossible to commit such a mistake. They would, in the very beginning, have relieved the Government from all that pressure of ignorant public opinion which the Government could not possibly, in the present state of things, withstand."

The present system of Special Committees is objected to by Sir William Thomson, and by other competent Witnesses.

Sir William Thomson thinks "that a single body would be better than a number of small Committees for advising the Government on the great variety of questions which from time to time would be likely to arise." Qu. 10,677.

Admiral Richards, late Hydrographer of the Admiralty, is of opinion that:

> Qu. 11,589. "The members of such committees must be selected more or less to fulfil certain political conditions, and that, as a rule, they would come new to the subject that they were going to consider, and I do not believe that the Commission which sat on the Naval Designs the other day was a very successful one. I do not know that any great advantages have arisen or are likely to arise from it."

Mr. Froude, in reply to the remark: "You do not consider Committees of that kind "to be a very satisfactory way of proceeding?" thus states his objection to the present system:

> Qu. 11,293. "I do not think so, because they have to find out the dream and the interpretation both, which is always a difficulty. They have to feel their way to a *locus standi*, which would already be possessed by a Council habitually operating with reference to the subject."

Additional examples of these defects are given, not only by these Witnesses, but also by others, whom we shall quote in that part of our Report which deals with the proposed remedies.

Evidence as to the Insufficiency of the present Appliances for Investigation

Our attention has been especially directed to the want of Laboratories for the use of the officials charged with Scientific Investigations urgently required for the economical management of the Public Departments.

Qu. 11,923. Mr. Anderson, the Superintendent of Machinery at Woolwich, who has been responsible for the expenditure of "very nearly 3,000,000*l.* of public money," points out that there are no means at the disposal of State servants to enable them to investigate questions on which large expenditure depends. With special regard to his own Department, he states:

Qu. 11,929. Qu. 11,950. "There is a very great deal which I should like to see taken in hand systematically. * * * * There is much that we are in the dark about; we are groping in the dark in almost everything at present."

Qu. 11,930. * * * * "Although we know a very great deal with regard to iron, cast, wrought, and in the condition of steel, there is yet very much which we do not know, and I am persuaded that if we could with certainty treat ordinary cast iron in the way that we sometimes do, nearly by chance, we would do away with three-fourths, or a very large proportion of the wrought iron which is now used in this country, and we should use cast iron. A great deal of the cast iron of commerce is not much above five tons per square inch in tenacity, but we can, by trying, get it up to 15 tons, although some of the reasons that determine that high character are obscure and it is very difficult to see what they are. I should like that the subject of cast iron should be thoroughly exhausted, and at the same time I should like to see the physical properties of iron thoroughly exhausted." * * * *

He next refers to another question of great importance to almost all the Public Departments:

Qu. 11,931. * * * "There is another very important subject which I might mention to the Commission. Some 20 years ago we were using 10 or 12 pounds of coal per horse-power per hour, and the majority of engines still require six pounds, but by the improvements that have taken place we are now down to two pounds. There is a little engine at work now in the London district which is working at $1\frac{3}{4}$ pounds. There is a great gulf yet between getting steam-engines that will work at $1\frac{3}{4}$ pounds per horse-power per hour, and the point where we are now; I mean getting that done practically; but I believe that if the right man, or two men, were told off to thoroughly investigate this subject, and not to stop working until they had brought it to a practical shape, we could in 10 years from this time get down to one pound per horse-power per hour. I see that there are very many leakages or loss in steam-engines in the very best way that we make them at present. The knowledge that was gained by Joule's experiments a few years ago seems to me to have been of immense value. Those experiments that he carried out for himself were the sort of thing which I think the Government should have done for the sake of the country. He did more to make engineers thoroughly dissatisfied with their present knowledge with regard to what they can do with steam than anything which had been done before. I believe that what Mr. Joule did will do more for this country than even what James Watt did. The part that James Watt took was very great, and the world gives him full credit for it, but the world is scarcely willing to give credit to Joule for what he will do; but he has made all engineers dissatisfied. They know that the best steam engine is not doing one-sixth of the work which it ought to do and can do. That is a sad state of matters to be in when we know that we are so far wrong, but yet no one will go to the trouble of going to the end of the question so as to improve the steam engine as it might be done; in fact, it will cost a great deal of trouble and a great deal of expense, I have no doubt."

Qu. 11,933. With regard to the question whether it is "desirable that the Government should establish any Laboratories for carrying on those investigations," he thus stated his opinion:

"I should like to see a grand laboratory fitted with everything that would go towards the investigation of such matters, and at the same time a testing apparatus for getting at the physical facts as well. To get up the proper plant would be very expensive, but still I should like the nation to have it, so that any public department could go to this same laboratory and ask them for assistance to investigate any doubtful point. * * * * In the Government service everybody who gets any work to do worth mentioning is overpowered with work—either they get too much or too little to do—and the investigator should not be bothered with such miscellaneous work. For example, take my own case, I may have 50 subjects in a day many times. Yesterday I had well on to 50 subjects to take up, and go into them all as well as I could, and I did not get over my work to write the paper which now lies before your Grace until 9 o'clock last night. A man is not in a position to pursue investigations when he is overworked in that way."

Mr. Anderson's Evidence finds a parallel in that given by Mr. E. J. Reed, M.P., late Chief Constructor of the Navy.

Qu. 12,706. "I think that there are many branches of science remaining undeveloped at present, the development of which would be of great advantage to the country. I base that opinion partly upon the experience which I acquired at the Admiralty, in which I continually found that great and important questions were undeveloped for the want of organisation and of the means of developing them."

Qu. 12,707. * * * "Mr. Froude in his evidence before this Commission stated that he had in hand a series of experiments for the Admiralty, having for their primary object the determination of the relations between form, speed, and resistance in ships, and, as he justly observed, this inquiry collaterally raises some other questions; but there is one subject related to that which Mr. Froude has under consideration, but which has not been developed at all yet, and it is one upon which very important financial questions hang; I refer to the dependence of the form of ships upon the weight of the materials composing their hulls. It will be obvious to the Commission that if you are going to build a ship for high speed of the thinnest steel, you can afford to prolong the ends of the vessel at either end, and give them extreme fineness in a manner and to a degree which would be preposterous, and I may even say monstrous, in the case of a ship which had to be built with very thickly-armoured sides. In this country the earlier ironclads were made of a form involving very long and fine lines, in fact a form analogous to that of mercantile steamships, and the consequence was that although in the 'Minotaur' type of ship armour and backing equivalent only to that used in the first instance in the

'Warrior' was employed, yet we got a ship 400 feet long, costing nearly half a million sterling. The impropriety of that course impressed itself upon my mind, and I believe it was more for that reason than for any other that I ventured to propose to the Admiralty a great change in that respect, and placed before them the design for the 'Bellerophon' as an example of a vessel which should be as fast as those long ships, and more effectually armoured, and much more handy, carrying at least as efficient an armament, and yet should cost about 100,000*l.* less. That policy was sanctioned by his Grace the Duke of Somerset; the 'Bellerophon' was built, and I believe long before she was finished the principle obtained so much favour that the idea of building another of the extremely long vessels never entered anybody's mind, and it was stated by the late First Lord of the Admiralty, Mr. Childers, in Parliament, officially, that by adopting that modification of form at least a million sterling had been saved to the county in the course of a very short time. But I wish to impress upon the Commission, if I may be allowed to do so, that that economy resulted from a mere tentative and limited application of a scientific principle, which has never been developed, and which the organisation of the Admiraly furnishes no means for developing. I indicated the nature of this investigation in a paper laid before the Royal Society some two or three years ago, but as the solution of it involves high mathematics on the one hand, and elaborate experimental investigations upon the other, it has never been taken up and dealt with in any sufficient way."

"A second illustration which I should like to give is this: the present condition of the marine steam-engine and boiler is very unsatisfactory. It is unsatisfactory to such an extent that I believe if the manufacture of iron and steel were improved with reference to its use in the construction of engines and boilers, and if improved material were applied by improved methods, a saving of one half of the present weight would be attained, and when I say one half I know that I am speaking greatly within the limits which some persons who have thought very much about this question would be prepared to express. Of course, if that be so, if we are carrying about in our mercantile and other steamships twice the weight which is essential for the production of the power, that is so much taken off either from the further power and speed which might be obtained, or from the freightage and commercial value of the vessel. I may mention that in the manufacture of shafts, for instance, of the marine engine and of stern posts, and other large forgings for ships, the method of production is comparatively rude, and it very much needs development. I for one feel the necessity of great improvement in these respects, because I know that at the present moment the successful production of those enormous forgings rests a great deal more upon the skill of a workman than upon the application of any science whatever to them. So much has the subject been neglected, that, at this moment, I have the responsibility of seeing some very large forgings indeed made for certain ships, and the most effectual manner in which I can give effect to my responsibility is that of selecting the very best working smith that I can find, and putting him into the manufactory where those things are being made, for him to do the best that his experience enables him to do, in order to see them properly constructed. I believe that if a regular independent scientific investigation were applied to a manufacture of that nature, enormous advantage would at once result." Qu. 12,708.

The Standards Department of the Board of Trade is another Department requiring advice in varied scientific subjects. The Warden of the Standards (Mr. Chisholm) states:

"There is no scientific authority to which I am entitled to appeal. It happens at the present time that I have the advantage of appealing to my former colleagues in the Standards Commission, to the Astronomer Royal and to Professor Miller, and I get a great deal of assistance from them in that way, especially from Professor Miller. In fact I could hardly have executed the scientific duties of my department without having assistance of that kind, but such aid has been obtained merely in consequence of my relations with them as a colleague. I am in no wise authorised to call upon them or upon any other scientific authority for information or assistance. I may here particularly refer to one subject which is mentioned in my paper, the preparation of new standard trial plates for coin. I actually required scientific information upon that point, and I could only apply to the Astronomer Royal, but his time was taken up so much that after some time he declined interfering in the matter, so that I have been obliged to act in the matter without having any scientific authority to aid me, although it is a very responsible duty cast upon me by law." Qu. 11,666.

Sir William Thomson, in reference to the subject of Standards, says:

"The conservancy of weights and measures is a subject involving questions of the most extreme scientific nicety. Faraday made statements showing how completely unknown at present are the properties of matter upon which we depend for a permanent standard of length. One of the very first objects that should be undertaken in connexion with the conservancy of the standards of weight and length is secular experiments, on the dimensions of metals and solids of other classes under various conditions of stress, temperature, and atmosphere. Those would involve scientific experiments of an extremely difficult character, and also operations extending from year to year. There ought to be just now a set of experimental specimens of solids laid up which should be examined every year, or every 10 years, or every 50 years, or every 100 years, the times when observations are to be made from age to age being regulated by the experience of the previous observations. It would be necessary to begin observing every month, then when constancy is attained within the degrees of observable minuteness to observe every year, then every 10 years, then perhaps every 50 years, and then it might be sufficient to look at them every 500 years, and examine whether this copper standard and that brass standard have retained precisely the same length. This would not be a very difficult or expensive thing to institute in such a way as eventually to obtain good results, but it would be an operation of a secular character, which could only be carried out by the Government." Qu. 10,678.

Dr. Frankland thus refers to the various requirements of Government involving Chemical Investigations:

* * * "The State requires many important investigations to be carried on. Such investigations are being continually conducted in buildings often very ill-adapted for the purpose, and which are fitted up for the purpose at a great cost. The laboratory of the Rivers Commission, for instance, which we have occupied for four years, was constructed in a house in Victoria Street; a rent of 200*l.* a year is paid for it, and it is literally nothing more than a moderate sized room, and two smaller ones, very ill-adapted for the purpose. Consequently, this laboratory is not so efficient as a building erected for the express purpose of conducting such investigations would be." * * * * Qu. 11,065.

In the Evidence which we have taken with regard to Astronomical Physics and Meteorology, the expressions of opinion as to the insufficiency of the means of investigation are so interspersed with suggestions as to the remedies to be applied, that we think it more convenient to refer more particularly to these subjects in the Third Part of this Report.

II.—The Assistance given by the State towards the Promotion of Scientific Research.

It may be convenient, for the purposes of this Report, to consider the Assistance given by the State towards Scientific Research as being either Permanent or Occasional.

Fourth Report.

Our great National Museums (upon which we have already reported) come under the first of these descriptions, and it will have been seen that for the purposes of the Student of the Biological and Geological Sciences, Collections are provided on an extensive scale, so that the Student of these branches of Science has advantages similar to those provided for the Student of Art or Literature.

On the other hand, the Student of the Physical Sciences has no such facilities; there are, at the best, for some of these branches of study, Collections of Instruments of a very inadequate kind, and relating for the most part to Applied as distinguished from Theoretical Science.

We have also reported to Your Majesty that the National Collections, so far as they illustrate the Biological and Geological Sciences, are rendered easily accessible to the Students of those Sciences. But the few instruments illustrative of Physical Science in any National Collection are so placed that they can scarcely be used even in the study of the History of Science. Moreover, as a mere collection of instruments, however complete, without working laboratories, is of little use to the Student of the Experimental Sciences, and as there are no Public Laboratories available for the Researches of Private Investigators, it may be said that in many branches of Experimental Science the State affords no permanent material aid to such Investigators.

Assistance of a Permanent Description is also afforded to certain Learned Societies, by providing them with apartments free of rent, or with annual grants of money in lieu of such accommodation: the sum of 500*l.* granted annually to the Royal Geographical Society under certain conditions is an instance of such a grant.

We may regard as a Permanent Aid to Science the grant of 1,000*l.* for Researches carried on by Private Individuals, which is annually voted by Parliament, and administered by a Committee of the Royal Society.

This Grant has rendered such great services to Science, that we desire to give the following Outline of its History.

The first proposal for such a grant was contained in a letter (dated October 24th, 1849) from Earl Russell (then Lord John Russell) to the then President of the Royal Society (the Earl of Rosse), and was to the following effect:

App. XI. vol. II. p. 41.

> "As there are from time to time scientific discoveries and researches which cost money and assistance the students of science can often but ill afford, I am induced to consult your Lordship, as President of the Royal Society, on the following suggestion:—
>
> "I propose that at the close of the year the President and Council should point out to the First Lord of the Treasury a limited number of persons to whom the grant of a reward, or of a sum to defray the cost of experiments, might be of essential service. The whole sum which I could recommend the Crown to grant in the present year is 1,000*l.*, nor can I be certain that my successor would follow the same course; but I should wish to learn whether, in your Lordship's opinion and that of your colleagues, the cause of science would be promoted by such grants."

Lord Rosse, in his reply to the proposal made by Lord John Russell, expressed his personal opinion that the judicious employment of grants in the way proposed "would very materially promote the Advancement of Science;" and of the two alternatives, namely, expending the 1,000*l.* in rewards or appropriating it to the payment of the expenses of experiments, he preferred the latter, indicating his reasons as follows:

App. XI vol. II. p. 41.

> "There are often details to be worked out before it is possible to employ usefully newly discovered principles. In many of the sciences reductions are required before observations can be made use of. Both in Science and Art facts technically called constants are the materials of discovery; to determine them accurately is of great importance. Now in all these cases, and in many others, the work to be done is laborious and expensive, and as it adds but little comparatively to the fame of the individual, it especially requires encouragement."

On this correspondence being communicated to the Council of the Royal Society, a Committee was appointed "to consider and report respecting the application of the "proposed grant." This Committee agreed to the following Recommendations:

> "First and chiefly—That the grant be awarded in aid of private individual scientific investigation.
>
> "Secondly. In aid of the calculation and scientific reduction of masses of accumulated observations.
>
> "Thirdly. In aid of astronomical, meteorological, and other observations, which might be assisted by the purchase and employment of new instruments.
>
> "Fourthly, and, subordinately to the purposes above named, in aid of such other scientific objects as may from time to time appear to be of sufficient interest, although not coming under any of the foregoing heads."

It was further added—

> "That a Committee be appointed, consisting of the whole Council for the time being, ex officio, together with an equal number of Fellows of the Society, chosen by the Council amongst the members most conversant with the business of the Royal Society, or with one or more of the leading departments of Science, or officially connected with the principal scientific bodies of the kingdom; such additional members to be named for a period of three years, subject to the annual revision of the Council, and provision being made for filling up the vacancy occasioned by such additional member becoming a member of Council during his term of service on the said Committee, should such occur." App. XI. vol. II. pp. *41*, *42*.

* * * * * * * *

With regard to this Government Grant, Sir Edward Sabine, in his Evidence, says:

> * * * "I suppose that the 1,000*l.* in one year was designed as an experiment to try the matter in the first instance. I always understood that Lord Russell contemplated that the sum would be augmented if the plan were found to work well." Qu. 11,135.

Neither the amount of the Grant, nor the conditions of its administration, have been varied from the time of its commencement. For full details as to its application in successive years, we refer to the Statement presented by Sir E. Sabine, and printed in the Appendix to Vol. II., at pp. *41* to *47*. In a later part of this Report, we shall refer to the proposals which have been made to us for increasing the amount and usefulness of the Grant.

The most important instances of the Occasional Assistance given by the State, are Expeditions for Special Researches, and Outfits of Ships, and Apparatus and Grants of Money for such Researches. These contributions are of great value, but they do not appear to be granted or refused on any sufficiently well defined principle.

III.—The Assistance which it is desirable the State should give towards Scientific Research.

We have received strong Evidence that it is the interest and within the proper function of the State to give efficient aid to the Advancement of Knowledge, even in those cases where such knowledge is not directly required for State purposes, and, we may remark, that some of the most decided expressions of opinion to this effect are those of Statesmen, whose views, owing to their official experience and their intimate knowledge of the exigencies of Parliamentary Government, are entitled to great weight on points involving increased grants of public money.

The Evidence of Lord Salisbury is emphatic:

Qu. 13,555. "Do you hold that the State may legitimately interfere in giving aid to the advancement of science?—I certainly do. It is a very orthodox doctrine to hold, and one which could be supported if necessary by quotations out of Adam Smith, the essence of the doctrine being, that the State is perfectly justified in stimulating that kind of industry which will not find its reward from the preference of individuals, but which is useful to the community at large."

Qu. 13,556. "The State has already, to a considerable extent, recognized, has it not, that duty; and there are a considerable number of scientific institutions supported more or less by the State?—No doubt the State, in the money that it gives, and has given in past times, to the best Universities, has recognized that duty."

Qu. 13,557. "There are the Observatory at Greenwich, the British Museum, and Kew Gardens; you would consider those as instances in which the State aids the promotion of science?—They would be all instances in point; and I do not apprehend that as to the abstract doctrine itself there has ever been any serious contest." * * *

Lord Derby's Evidence in favour of State Aid to Science is all the more weighty from the limitations by which he guards it:

Qu. 13,513. "I think there has been a very general consent amongst a large number of men of science who have been examined before this Commission that in the present state of science there are many branches as to which there is no probability of their being advanced to the degree to which they are capable of being advanced by private effort, and without the assistance of State funds in some shape; what is your Lordship's opinion upon that subject?—I am, as a general rule, very strongly in favour of private effort, and very decidedly against the application of State funds to any purpose that can be accomplished without them; but I think that if there is any exception to that which I venture to call a sound and wholesome rule, it is in the case of scientific research, because the results are not immediate, they are not popular in their character, and they bring absolutely no pecuniary advantage to the person engaged in working them out. A great mathematical or a great astronomical discovery is a benefit to the whole community, and in a certain sense to mankind in general; but it is productive of absolutely no benefit, in a pecuniary point of view, to the person who has given his labour to it.'

Sir Stafford Northcote thus states his opinion on the point:

Qu. 13,623. * * * "The State should do what it can both to promote scientific education and also to assist in the prosecution of scientific experiments and inquiries when they can be best prosecuted by the aid of the State."

On the proposition that it is the duty of the State to encourage Original Research, we might multiply our extracts from the Evidence indefinitely. Dr. Frankland, Sir W. Thomson, Dr. Joule, Mr. Gore, Dr. Carpenter, Professor A. W. Williamson, Mr. Reed, Sir E. Sabine, Dr. Siemens, Dr. Sclater, Mr. Farrer, Admiral Richards, and numerous others, show that the Aid of Government to Scientific Research has been beneficial, so far as it has gone, but that it has been insufficient and should be increased.

We have selected the Evidence of Dr. Frankland and Sir W. Thomson from amongst that given by men of Science.

Dr. Frankland's Evidence is to the following effect:

Qu. 5883. "Setting aside the interests of science, what would be your expectation under equal circumstances otherwise, in reference to two countries, in one of which scientific research was neglected, whilst in the other it was pursued with considerable vigour, with regard to the progress of the arts and of manufactures?"

"In my opinion there could not be any doubt but that the nation which neglected science must suffer in the end, because although it could buy scientific inventions from the other country, yet still it would always be behind, as it were, in the market; it would have to follow the lead of the other country, which I imagine would be a commercial disadvantage."

Qu. 5884. "Might it not also be the case that the appreciation of the commercial value of scientific inventions would be very much more uncertain in the one country than in the other?"

"Yes. It is also much more difficult to establish manufactures upon new inventions in a country which neglects science, because you cannot have either workpeople or managers competent to conduct those processes which depend upon scientific principles."

Qu. 5885. "People might pay large sums for what was worthless, and neglect that which was of great value?"

"They might."

Qu. 10,736. Sir W. Thomson emphatically asserts that, in his opinion, it is of the most immediate consequence to the honour and welfare of the country that men should be enabled to live on Scientific Research, and that a definite and secured position should be given to Scientific Workers.

In another part of his Evidence he states:

> Qu. 2,693. * * * * "There are many investigations which can only be done by the nation as a whole; and viewing the Government in one sense as acting for the nation, as it were a committee of the whole nation, there are very many investigations not merely of importance with reference to promoting the material prosperity of the nation, but valuable to the nation as promoting scientific discoveries, in which the whole nation takes a pleasure, and from which the whole nation derives as great benefit as anything material can possibly produce. Investigations for which a large expenditure of money is necessary, and which must be continued through long periods of years, cannot be undertaken by private individuals. Generally speaking, I believe that if the Government is well advised in respect to science, it will be for the good of the nation that the Government should make it part of its functions to promote experimental investigations in science."

Qu. 12,642 As representing the opinions of public servants occupying high official positions in Government Departments, we may refer to the Evidence of Admiral Richards, late Hydrographer of the Admiralty, and to that of Mr. Farrer, Secretary to the Board of Trade, the latter of whom, in answer to the question—"Have you formed any opinion "as to whether further grants ought to be given by the Government for Scientific Research?" says:

> "I can only give an opinion which is of very little value; but I think there can be no doubt whatever that there are numerous subjects, and always will be numerous subjects, in which private observers are unable to do what is wanted. For the older sciences you have had observatories established at the Government expense, for astronomy, and now, recently, for meteorology; and those cannot be the only sciences to which assistance ought to be given on the same principle."

Evidence relating to the Establishment of Laboratories.

We proceed to give extracts from the Evidence placed before us in reference to the need of Laboratories for conducting alike Chemical, Physical, Metallurgical, and Physiological Inquiries, both for Departmental Work, and for the Researches of Private Individuals. Where the Evidence is of a general character, and includes proposals regarding Observatories also, we give it here, although we shall deal with the special question of Physical Observatories separately.

Amongst the witnesses who are in favour of the erection of new Laboratories for Research is Colonel Strange, whose view of the National Requirements in these respects is thus given:—

> Qu. 10,441 "Will you be so good as to enumerate the institutions which you think should be under the State?—(1,) an observatory for physics of astronomy; (2,) an observatory for terrestrial physics, namely, meteorology, magnetism, &c.; (3,) a physical laboratory; (4,) an extension of the Standards Office; (5,) a metallurgical laboratory; (6), a chemical laboratory; (7,) an extension of collections of natural history, and an able staff of naturalists; (8,) a physiological laboratory; (9,) a museum of machines, scientific instruments, &c. I believe that under one or other of these and existing institutions every requisite investigation will range itself. I have not stopped to inquire whether one or another is more or less important. My aim in the spirit of my postulate No. 2 has been *completeness*. It may be necessary for a manufacturer to prosecute only such particular investigations as promise direct and speedy profit. A great nation must not act in that commercial spirit. All the operations of nature are so intimately interwoven, that it is impossible to say beforehand that a given line of research apparently unproductive may not throw light in unsuspected directions, and so lead to untold and undreamt of treasures." * * * *

Sir W. Thomson's Evidence is as follows:—

> Qu. 10,696. "Are you of opinion that any national institutions supported by the Government are required for the advancement of science?—I think that there ought to be institutions for pure research supported by the Government, and not connected with the Universities. The only suitable place at present for such institutions would be London, or the neighbourhood of London; in that situation, I believe, very great things could be done by institutions for pure research, at which work of a very great immediate money value would be produced at an extremely moderate cost, and I believe that discoveries redounding to the honour, and credit, and pleasure of this country would infallibly be made."
>
> Qu. 10,697. "Are you able to give any idea as to how many such institutions would be required?—There should be five. One at present exists, namely, the Royal Observatory at Greenwich. Another in my opinion is very much wanted, an observatory for astronomical physics, then again a physical laboratory, and a laboratory for chemical research, and a physiological laboratory are necessary." * * * * *
>
> Qu. 10,703. "Would such a physical laboratory differ in any essential respects from a physical laboratory attached to an University?—Yes; it would be adapted solely for research, with no provision for pupils except what may be called apprentices, or pupils for research; no provision for teaching the mere elements of manipulation, but provision for researches directly adapted to increase knowledge, and for making pattern researches for the sake of training research pupils who had already gained experience and proved ability in institutions of instruction."
>
> Qu. 10,704. "Would you leave the researches to be carried on at such a laboratory mainly to the discretion of the person who had charge of it, or would you place it in any degree under the control of the council of which you have been speaking?—I would leave it to the discretion of the person who has charge of it." * * *

Qu. 10,705. "And that the Government should also be able to command investigation on the advice of the council?—Yes."

Qu. 10,706. "Of course the director would report?—Yes, the director would report on everything, both researches undertaken at his own instigation, and investigations undertaken for the council, or for the Government."

Qu. 10,707. "And your view of what should be done in the chemical and physiological laboratories would, I presume, be something of the same nature?—Yes, something of the same kind, *mutatis mutandis*."

Qu. 10,709. "With respect to the apparatus, and the annual supply of apparatus, it is probable, is it not, that the physical laboratories would be the most costly?—Yes, the most costly in apparatus."

Qu. 10,710. "Some very fine instruments of a costly kind are now required in physiological inquiries, and large pieces of apparatus are sometimes employed, such as the respiration apparatus at Munich, which was put up on the recommendation of Professor Pettenkofer?—Yes, it would be in my opinion necessary not to limit to a fixed endowment the expenditure of any one of those institutions, but to let it be determined (if I may use the expression once more) by natural selection; applications for money to be made to the council to be duly weighed, and the council to apply to the Treasury. That would be much more economical than giving a fixed sum which, being to be spent, might be spent without due regard to economy, or which, on the other hand, might prove to be insufficient for valuable researches, causing the institution thereby to be crippled and to lose efficiency.'

Qu. 10,711. "You would not think it indispensable, would you, that such institutions, if the Government thought fit to establish them, should be in the heart of London, or in any very central situation?—No; it would be much better that they should be in the country in positions conveniently accessible to London. For a physical laboratory quietness of the ground is of immense importance. It would be impossible to make a great deal of the most important scientific investigations in a physical laboratory within 100 yards of any of the great thoroughfares of London, and a much greater distance than 100 yards is quite necessary for many such investigations."

Qu. 10,712. "You would not institute any regular provision for teaching in those laboratories?—No."

Qu. 10,713. "But you would allow young men or students who wished to carry out original research to avail themselves of them under the direction of the persons who were in charge of them?—Yes, under the direction, and to some degree under the instruction of the persons in charge; but the instruction should be limited to methods for advancing science. The director of such an institution must not be occupied with lecturing in any other institution, or with lecturing at all. He ought indeed to be prohibited from lecturing, except one or two occasional lectures in the course of a year."

Qu. 10,714. "You think that the object for which you recommend the establishment of those laboratories could not be accomplished by any other means—not by investigations carried on in other laboratories in the country?—Certainly not by any other means."

Dr. Frankland thus refers to the double function which such Laboratories might perform, and states his view in reference to their management:—

Qu. 11,064. "Can you make any suggestions as to stimulating original research in this country?— * * * We have in this country a considerable body of investigators who are not engaged in teaching at all, and I think that this is a peculiarly hopeful feature of our case. It shows that the English have not only a taste for research, but that they have a natural talent for it. We have numerous men like Mr. Gassiot, Sir W. Grove, Dr. De La Rue, Mr. Spottiswoode, Mr. Huggins, Mr. Duppa, Mr. Buckton, Mr. Joule, Mr. Lockyer, Mr. Perkin, Mr. Schunck, Colonel Yorke, and others whom I could name, who are not in any way engaged in teaching, and never have been, but who have made important original researches, and have spent a good deal of their time in the working out of new discoveries. Now that method of stimulating research, which I have mentioned in my former examination, would not of course apply to them. Men of this class are really peculiar to England, for I have never known any such instance in Germany or in France, of men altogether disconnected with teaching taking up research in the way it is done in England. I think that for such men the establishment of national institutions such as those which are recommended by Colonel Strange would be peculiarly useful. In fact, I have heard several of these gentlemen express strong opinions as to the great advantage it would be to them if they could go to some institution of that kind to conduct research, where expensive instruments, which are often required for their experiments, were provided for a number of such investigators, and where appropriate rooms for carrying on these researches could be had. It is exceedingly difficult to carry on chemical research in one's own house, because of the want of proper contrivances for dealing with corrosive gases and vapours; and hence appropriate buildings ought to be provided for carrying on such investigations. I think, therefore, that it would afford a great stimulus to research of this kind if such institutions were provided, and furnished with such instruments as would be generally useful in research, leaving the more special instruments and materials adapted to the particular researches themselves, to be provided by each operator. * * * I have reason to believe that no inconsiderable number of men, more especially of those educated in some of the science schools, would undertake researches if such facilities were afforded them."

Qu. 11,065. "Would you consider the chief use of such institutions as laboratories to be to enable private inquirers to carry on their researches, or would you propose that any investigations should be carried on there on behalf of the State?—I think that both things might be provided for. The State requires many important investigations to be carried on. * * * That might well form one part of the objects of such a building, but I should think that so far as abstract research, of which we are more especially speaking now, is concerned, the other portion of those objects, namely, the encouragement of original investigation in the case of amateurs would be more important, because the investigations made for the Government are essentially practical investigations; they are not usually of that character which lead to discoveries or to the advancement of science."

Qu. 11,066. "Would you place those laboratories under a permanent official?—They must of necessity be under the direct and constant superintendence of some one thoroughly conversant with the operations going on in them; and, so far as the conducting of the separate original researches is concerned, I think that it would be very desirable that the admission into such institutions should be granted through some such body as the Research Fund Committee, for instance, of the Council of the Royal Society, or some body of that kind, who would make intelligent and impartial inquiry into the qualifications of the men applying for accommodation."

Qu. 11,067. "You would not throw upon the director the sole responsibility of deciding who should be admitted and who should not?—I think that would not be desirable."

Qu. 11,068. "And I understood you to say that you would not think it desirable that the Government should direct any specific original research to be carried on, except with reference to some practical purpose?—Except with regard to subjects about which the Government wished for information, I think it is much better for each man to devise his own research; he takes much more interest in it, and is much more likely to pursue it with vigour than if it is prescribed for him."

Qu. 11,069 "And do you think it would be requisite that those institutions should be on a large scale?—I think that they ought to be on a fairly large scale even to begin with, because it is always a costly process to rebuild such institutions; and I am inclined to think that they would be rapidly filled. A tolerably large institution of that kind would probably in a very few years be filled with workers."

Qu. 11,070 "You would not recommend, in the first instance, at least, more than the establishment of one for each department of science?—I think not more than that."

Qu. 11,071 "And should it be in London?—Yes, I suppose they must be commenced here, but eventually it would be desirable that the important centres in the provinces should also be furnished with such places."

Qu. 11,072 "Colonel Strange recommended the establishment of four laboratories; should you be disposed to agree with him in that view?—Yes, I think that those would be necessary; perhaps the least essential of them would be the metallurgical one, but certainly the others would be quite essential."

Qu. 11,073 "Could that be combined with the chemical laboratory?—I think the metallurgical one, in the first instance, might be combined with the chemical laboratory, as the processes are similar. There would be the chemical laboratory, the physical laboratory, the physico-astronomical, as we may term it, and the biological. It would be necessary, in connexion with the physico-astronomical observatory, to have the means of performing various chemical experiments and making physical observations. Of course the chemical operations would be quite subsidiary to the cosmical observations there."

Mr. De La Rue expresses himself as follows:—

Qu. 13,054 "Are you of opinion that any new institutions in the way of laboratories should be established by the State?—I hold it to be so important that Chemistry should be extensively cultivated in England, that I would strongly advocate that there should be a State laboratory. That State laboratory should undertake all the chemical work which the Government might require, but at the same time, according to the views which I hold, it ought to be such an establishment as could afford facilities to men who have completed their scientific education, and who might be desirous of continuing original investigations, in which space for working and instruments should be afforded them, and, moreover, if men were not in a position of fortune to continue their researches, in some cases materials and even money might be granted to them on the recommendation of the council. I may state that of my own knowledge I know that chemical science at present is not progressing in England in a satisfactory manner, that we do not make so many original researches as our continental neighbours, particularly the Germans, do. In Germany very great patronage is given to science, magnificent laboratories have been built, and the students, who, after they are sufficiently advanced, are encouraged to make original investigations, contribute at present most largely to scientific Chemistry."

Qu. 13,063 "Do you think that the establishment of those Government laboratories would be likely to give rise to complaints from any existing institutions?—I think not, if those Government establishments were not educational establishments. There would be a natural jealousy on the part of educational establishments if the Government were to undertake to educate students without charge; but what I contemplate is merely that facilities should be given to men who have already been educated, and not to interfere at all with the functions of educational establishments."

Qu. 13,105 * * "I think that some good might be done by aiding educational establishments; but I believe that the more advantageous course would be for the State to afford facilities in the laboratory which it might require for other purposes."

Qu. 13,057 "Do you think that any other laboratories would be needed?—I attach the greatest importance to a chemical laboratory, because I believe that Chemistry is destined to play a very important part in the advancement of the arts in all civilised countries, but there also ought to be a physical laboratory, very much on the same footing as the chemical laboratory, and in which facilities should be afforded for conducting physical investigations."

Qu. 13,058 "You would give admission to those laboratories on the same principle as to the chemical laboratories?—Yes, to men who could show that they were qualified to make a beneficial use of them."

Qu. 13,059 "You think that any investigations required by the State should also be conducted there?—Yes, they should be conducted in either the chemical or physical laboratory, according to the nature of the investigations. For example, there were a great number of investigations carried on at Woolwich relating to the strength of different alloys whose chemical composition was determined by analysis. Such investigations would be very well conducted in the chemical laboratories."

Qu. 13,077 "Would you transfer the work now done at Woolwich to such a laboratory?—Part of the work, but I would except such special work as could be better done at each of the Government establishments. Special investigations would fall within the duties of the central government laboratory. The testing of the purity of the products to be used in the department, and routine work, would be better conducted in those establishments."

Qu. 13,078 "With respect to the other purpose of the laboratory, do you think that there would be a sufficient number of independent inquirers to occupy an establishment like that?—I think that there would be a great number of men who would be very glad to avail themselves of such opportunities as a laboratory of that kind would afford, and their doing so would not add materially to the cost of the establishment."

Mr. Gore also recommends the establishment of Laboratories:—

Qu. 10,782 "Are there any measures that you can suggest to the Commission which you wish to see adopted in order more effectually to promote this object than is the case at present?—I propose that national laboratories should be established, in which abstract scientific investigation alone should be carried on. I propose that in those laboratories scientific investigators should be wholly employed upon abstract original investigation, and be paid for their labour and be supplied with the necessary means in their respective sciences, leaving each investigator to choose his special subjects of research."

Qu. 10,784 "Perhaps you could explain to the Commission rather more fully what should be the general character of those laboratories?—For making original scientific investigations in the subjects of chemical physics and chemistry. I speak only within the subjects with which I am familiar."

Qu. 10,785 "Do you refer, in this recommendation, to the establishment of a physical laboratory?—If you mean by a physical laboratory one in which the sciences of heat, light, electricity, and magnetism would be investigated, I should mean a physical laboratory."

Qu. 10,786 "And you think that that ought to be distinct from a laboratory for chemical physics and chemistry?—Yes, I think distinct from the laboratory for chemistry only."

ı. 10,787. "I understand you to recommend that this should be a Government institution supported entirely by Government funds?—Yes, I do recommend that."

We next proceed to refer to the Evidence in which other views are expressed. It will be seen that it is rather in favour of the utilization and extension of existing, than of the establishment of new Laboratories. We shall confine ourselves to extracts from the Evidence of Dr. A. W. Williamson, Dr. Siemens, Dr. Burdon Sanderson, and Lord Salisbury.

Dr. A. W. Williamson—

u. 12,696. "A good deal of evidence has been offered to the Commission in favour of establishing and maintaining laboratories of research at the expense of the State, in order to give opportunities to original inquirers to carry on investigations. Have you formed any opinion of the expediency of such arrangements?—I think that to establish a laboratory for research only would be beginning at the club end, and would be decidedly inadvisable. I think that the main thing for research is to give to schools, and especially to the higher schools, proper facilities for it, and to develope them greatly. At the same time, it is quite possible that, in exceptional cases, research might with advantage be carried on in separate places; but I should always view with regret, as a waste of resources, the separation of that higher work of research from the more humble work of teaching, which naturally belongs to it. They help one another, and I think that each would lose from being separated from the other; still, in some cases, it might possibly be advisable."

Dr. Siemens—

u. 11,804. "What is your opinion as to the establishment of laboratories at the Government expense?—I would recommend the establishment of observatories but not of laboratories, for the same reason, that in laboratories unconnected with teaching, as have been proposed, using the public conveniences, and public money, there would be a necessity for results which would lead to a certain extent to something approaching charlatanism in the enunciation of those results; and, moreover, I consider that it might lead to disappointment in many, who would believe that they had an equal right with others to take advantage of such establishments."

ı. 11,805. "Do you consider that laboratories are required in greater numbers, and better equipped than they are at present?—I think so, decidedly."

u. 11,806. "But still you would not remedy that defect by establishing Government laboratories?—Not by establishing Government laboratories, but by granting Government aid towards the establishment of laboratories, and chiefly by the endowment of chairs."

u. 11,807. "Do you think that laboratories should chiefly exist in connexion with universities or other teaching institutions?—I think so, because we should always look to the coming generation, upon which the future depends chiefly; and a well appointed academical laboratory presents great opportunities for a student, under a great leader, to attain to eminence himself."

u. 11,820. "With reference to national physical laboratories, it has been suggested to the Commission by several witnesses that such laboratories might be of use, not so much for the researches to be carried on officially in them, but as giving opportunities to private individuals for carrying on researches in them; has it occurred to you whether, in that point of view, they might be useful or not?—They might be useful in certain cases; but if the Government takes in hand such a thing, there must always be favouritism. It would be impossible to grant such facilities to all applicants, and it would be very difficult for the Government to use such discrimination. Any university or society could do so by granting facilities to men who had given promises of success by reading papers, or by fully explaining their objects in view; but for the Government to use such discretion would be impracticable, I think."

u. 11,821. "Then you think that there should be such laboratories that should be available to persons who could not afford, for instance, to have a physical laboratory of their own, but you do not think that such laboratories should be under the control of the Government, or should be Government institutions?—They should be exceptional cases altogether. If, in any existing laboratory, whether Government or otherwise, an instrument existed necessary for certain research, I think that facilities might be given occasionally to an applicant, but I am of opinion that it would not be desirable to establish what might be termed a national workshop of science."

u. 11,822. "Is there any such institution in Germany as a physical or other laboratory (apart from astronomical observatories), independent of an university or an educational establishment?—I believe not. There are laboratories connected with Polytechnic or Mining schools, but still they are connected with teaching."

u. 11,823. "Has any difficulty been found in affording facilities in those laboratories to original inquirers who may not belong to the school?—It would not be difficult for any one to get access, for instance, to the laboratory of an University. If he entered his name, he would be allowed to go into the laboratory, and, under certain restrictions, imposed by the Professor, carry on his researches."

u. 11,824. "Are those laboratories, as established in Germany in connection with the universities and other educational institutions, quite sufficient for all the wants of science and of original investigation in science?—Whether more might be done by increasing their number I am not prepared to say, but still there seems to be no expressed want for additional laboratories."

Qu. 11,825. "At any rate you would not propose to establish laboratories on a different footing?—No."

Dr. Burdon Sanderson—

Qu. 12,302. "Will you proceed to state in what way you consider that money might be applied for the promotion of physiology?—I consider that it might be available for three purposes; namely, for the improvement of laboratories, for the providing of instruments and materials for research, and for the remuneration of workers. I will speak first of the spending of money upon the improvement of laboratories. I do not myself see at the present moment that we are in a position to require the expenditure of large sums of money upon the building of large laboratories, for this reason, that if such laboratories were built we should not have workers to work in them; at present we have not men to work in the laboratories that we actually possess. We have men of a certain class, but we have not men of that trained class which we require. I am of opinion that a physiological laboratory to be of any use at all must be in connexion with the great schools of medicine. A physiological laboratory at a distance from such schools would fail for want of people to work in it. Physiology will never flourish, therefore, excepting in connexion with the two arts which are dependent upon it. Just as vegetable physiology will flourish best in connexion with agriculture, so also animal physiology will flourish best in connexion with medicine. I think that grants might be very advantageously given for the improvement of the laboratories now existing. Of course, in the administration of such grants, one would go upon the principle 'to him that hath shall be given;' that is to say, wherever a good laboratory exists, or wherever men are to be found to work a laboratory, and where there are likely to be students to work in it, money should be given to carry out improvements. I would further notice that in physiological researches, the expenditure for materials is usually much greater than for instruments, and consequently money is more wanted for current than initial expenses; for this reason large sums ought not to be expended in the purchase of collections of costly instruments, for if such sums were spent they would probably not be used. It is much better to provide money to assist to meet those heavy expenses which are required for material. To show this it would merely be necessary to refer to some of the physiological researches which are now being carried out, in which a great expenditure is required for material, but no tremendous expense for instruments. Of course I do not mean to say that it is not necessary to spend money on instruments, but any expenditure on a large scale for this object would be very likely wasted. On the whole I believe that money can be more economically spent in sums paid for work done than in any other way, *i.e.*, either in the way of periodical payment to men of acknowledged competency, for the purpose of carrying out inquiries of long duration, or in the form of separate grants for special researches, or in the form of grants for skilled assistants. * * * * Of course in Germany men who do this work are not paid, and it is very necessary to bear this in mind, but the difference there is that such men have something to look forward to. There are in Germany numerous teaching appointments to which a man can look forward with the certainty that if he works industriously for a certain time, he is sure to get an appointment of some kind afterwards, which will enable him to take the position of a professor. This state of things does not exist in England, and therefore it is more necessary in England to encourage the younger men to engage in research by pecuniary aids than it is in Germany."

Lord Salisbury—

Qu. 13,590. "In speaking of the establishment of laboratories by the State, your Lordship appeared to me rather to refer to chemical laboratories; but it has not escaped your attention, I am sure, that the cost of physical apparatus is so very great as to put physical inquiries really out of the reach of a very large number of persons who probably might be capable of conducting such researches; and in consequence of there being no such assistance assigned to such persons as a State laboratory, in which they could obtain the use of apparatus, and of a really fitting building, constructed with sufficient solidity for the purposes of research, a great many persons are prevented from entering upon researches of that kind by the want of means; and it has been contended that by providing laboratories, at the expense of the State, you would be doing no more for such persons than has been done for learned men by providing them with great public libraries, as you would be only providing them with the opportunities of research, which otherwise they could not have?—My fear would be that there would be a difficulty in providing laboratories in sufficient numbers to satisfy all, as you can provide books at the British Museum to satisfy all, and that the result would be that very often those who are least fitted to obtain any useful result would engross the instruments. For the purpose of really first-rate workers, I think that the Government might very advantageously be liberal; but such liberality I think would best take the form of an increased grant to the Royal Society. But I should be doubtful whether it was possible by any moderate expenditure of funds to provide an expensive class of scientific instruments of all kinds for all the persons who might be inclined to use them."

Evidence relating to the Establishment of Physical Observatories.

On the general question of the Establishment and Maintenance of Physical Observatories, Lord Salisbury agrees that:

Qu. 13,575. * * * "Some of these institutions which have been alluded to in your Grace's question, especially observatories, clearly fall within the duties of the Government; and certainly, from all that one hears, it is probable that their duty in that respect is inadequately performed, and that observatories for a much larger range of observations might with great advantage be multiplied." * * * *

Sir George Airy thus states his view on the subject:

Qu. 10,481. "When I began to be an astronomer, such questions as those of the constitution of the sun and the like were not entertained." * * * *

Qu. 10,485. "Are you prepared to express an opinion as to whether it is an object which would be a proper one for the Government to take up as a State establishment?—The Government are already pushed very hard in their estimates. The screw is always put upon them, 'Cannot you reduce the estimates a little more?' And then it would always come to a question of extensive feeling in the House of Commons, and of popular feeling out of the House of Commons; and I am confident from what I have seen that those two bodies would not in every case support an extension." * * * *

Qu. 10,486. "Should you say that it is an object which is not very likely to be prosecuted with sufficient vigour unless taken up by the Government?—I do not see how it could go on except it were taken up by the Government. I do not believe that it could go on in any other way."

Qu. 10,487. "It is not likely, you think, to be prosecuted by private individuals, or by other public bodies such as the Universities?—No; I think that their funds are almost all required for other objects, and the difficulty even of getting the business into shape is extremely great." * * * *

Qu. 10,488. "Then such observations, in all probability, will either not be made at all or must be taken up by the Government?—That is my view." * * * * *

Mr. De La Rue's opinion is thus given in reply to question 13,066:

Qu. 13,066. "I think that the time for the State providing means for reducing observations has now come; when the State should take up, besides mathematical astronomy (which deals with the places of the stars and planets, and the moon especially), physical observations, more particularly observations of the sun, which appear to me to bear directly upon meteorological phenomena." * * * *

He says further, in regard to observations of this nature, that they necessitate "a
" certain staff of assistants, and require continuous superintendence, hence it is necessary
" that an amateur astronomer who undertakes such work should have leisure during

"the day, and that he should be able to pay for duly qualified assistants, and such men "have to be highly paid."

Sir W. Thomson points out the importance of multiplying such Observatories:

Qu. 10,698. * * * "In respect to the observatories, it might be necessary to have several observatories for astronomical physics in this country, if it were only to secure observations of interesting conjunctures, notwithstanding the varieties of the weather, that there may be in different parts of the country; and, again, observatories for astronomical physics ought most certainly to be founded in other parts of the British dominions than England, Ireland, and Scotland; in other latitudes and on the other side of the world."

Dr. Siemens expresses the same view in the following Evidence:

Qu. 11,789. * * * "An observatory or several observatories should be established for carrying on physical research, research to obtain information on general subjects, such as solar observations, magnetic observations, and other subjects that might be thought desirable to obtain continually information upon." * * * *

Qu. 11,864. "I think that almost the only new establishments which you recommend are certain physical observatories? —Yes."

Qu. 11,865. "What would be the principal object of such observatories?—For the purpose of magnetic observations, solar observations, and other general inquiries into physical phenomena."

Qu. 11,866. "Do you contemplate the establishment of more than one such observatory?—Probably more than one would be desirable."

Qu. 11,867. "Do you contemplate the establishment of any such observatories in any of the colonial possessions of the country?—Yes, I think so."

Qu. 11,868. "Speaking generally, would they be costly establishments to found?—Not very costly, not so costly as astronomical observatories."

Dr. Frankland has also given Evidence on the importance of promoting the study of Qu. 11,073. Astronomical Physics, pointing out that "It would be necessary, in connexion with the "Physico-Astronomical Observatory, to have the means of performing various chemical "experiments and making physical observations. Of course the chemical operations "would be quite subsidiary to the cosmical observations there."

Qu. 13,067. Mr. De La Rue, in reference to locality and organization, in answer to the question whether provision for carrying out Observations of this character should be in connexion with the Greenwich Observatory, says:

"In connexion with the Greenwich Observatory, yes, but at the Greenwich Observatory I should say not. I do not think, in the first place, that there is space enough at Greenwich, and the duties of the staff are already so very onerous that it would require a separate establishment for such special work; besides other new buildings it would entail a chemical laboratory, and there is hardly space for those at Greenwich. I believe also that it would cause too divided attention on the part of the Astronomer Royal, if he were called upon to personally superintend investigations in the physics of astronomy, although I think it would be very desirable that any new establishments, if they are to exist, should be affiliated to Greenwich."

Being asked whether the new establishment should be in the neighbourhood of Greenwich? he replies:

Qu. 13,068. "Not at all necessarily so. In fact Greenwich would not be at all desirable for some class of observations, it is much too near London."

Qu. 13,069. And in answer to the question "Would you place the proposed new observatory for "those purposes in any respect under the control of the Astronomer Royal?"—

"It would be desirable that the State should have to deal only with one astronomer. Possibly by the increase of the claims upon his attention it might be desirable for the Astronomer Royal to have directors under him, so that he should not have to devote so much time to details even of the Greenwich Observatory, but I do not think that the State ought to have to deal with a great number of astronomers, indeed there might be some difficulty in its doing so."

Qu. 13,071. He says further, "In order to obtain a daily record, I would advise that one or possibly "two observatories should be established in India, and one at the Cape of Good Hope." "At the Kew Observatory it was frequently cloudy for several consecutive days."

Admiral Richards says:

Qu. 11,625. "If you are going permanently to establish physical observatories, I should prefer to see separate ones. I think that the physical work probably would be better separated from the Royal Observatory."

Qu. 11,626. "You think that the two classes of observations are so distinct in character as to render that desirable?—Of course there is a certain amount of meteorology that must be observed at the astronomical observatory; but it need not be of any extended character."

Qu. 11,991. Mr. Spottiswoode's Evidence is as follows:—

"The Observatories which you recommend could, in your opinion, be attached to existing Observatories; an Observatory for Solar Physics, for instance?" "This might be met by an extension of the existing Observatories."

Qu. 11,992. "Do you think that it would be as useful, if attached to Greenwich, as if a special observatory were established for the purpose?—I have no doubt that if an independent observatory were adapted to that purpose and furnished with adequate instruments, and manned by such a staff as one could wish, more would be done in such an independent observatory, so manned, than by a branch of the Royal Observatory at Greenwich, but, at the same time, that would involve such a much larger expense, that I thought that the question of expense would perhaps outweigh the scientific advantages to be gained by it."

"Do you think that a great deal might be done by making some additions to the present Observatories?"

"A great deal, because in a large observatory there are, not unfrequently, instruments only partially employed. For example, at Greenwich there is a large and very fine instrument suited to the investigation of solar physics, which is, at all events, largely disposable for such observations." Qu. 11,993.

It will be seen that most of the Witnesses dealing with Physico-Astronomical Observations recommend that, whether or not they be placed under the control of the Astronomer Royal, they should certainly beconducted by Special Directors, and be placed by preference in localities which the Witnesses deem to be better adapted to the purpose than Greenwich.

Such is not the opinion of the Astronomer Royal himself. Sir George Airy thus deals with the question specially referring to the difficulty as to space at Greenwich, and the mode of management:—

"Do you think it would be practicable to adopt any measures at the present observatory at Greenwich to make observations of that character?—I think it is possible that it might be done, but I am not prepared with a plan at present, and I am very much inclined to think that the difficulties in these matters will be rather in detail than anything else. There is always a difficulty in keeping an observatory of rather an indefinite character in such a state that it will satisfy the public demands." * * * Qu. 10,482.

* * * "It has been found necessary within the last three or four years to extend our grounds at Greenwich. * * * Judging from what occurred in our case, I do not think that there would be any difficulty in further extension; where it would be in sufficient proximity to the Royal Observatory to be under the same general control." Qu. 10,483.

"If a department of that kind were instituted, do you see any objection to its being placed under the Astronomer Royal, or would it give him too much to do?—It would give him much to do, but a great deal may be effected by organisation, especially with the license to have officers of good position under him; to have lieutenants of a good class." * * * * Qu. 10,484.

A Resolution in general accordance with the views expressed by Sir George Airy was transmitted to us in July 1872, by the President and Council of the Royal Astronomical Society. This Resolution is in favour of the extension of the Royal Observatory at Greenwich and other existing Astronomical Observatories, and does not recommend the Establishment of an independent Government Observatory for the cultivation of Astronomical Physics in England. Appendix VII., Vol. II. p. 31.

In connexion with some points on which differences of opinion have been expressed in this Evidence, we give the following extracts from a Paper handed in by Colonel Strange, consisting of questions addressed by him to Professor Sir W. Thomson, Professor Hilgard, the Secretary of the American National Academy of Sciences, and Professor Balfour Stewart, and to M. Faye, the President of the French Academy of Science; and their replies thereto. Vppendix AII., Vol. II. pp. 27–31.

Colonel Strange's questions, and the replies to them, were as follows:—

"(1.) Is the systematic study of the solar constitution likely to throw light on subjects of Terrestrial Physics, such as Meteorology and Magnetism?

"(2.) What means, at present known to Science, are available for studying the sun?

"(3.) Do you consider that Photography (one of the assumed means) will suffice for the purpose?

"(4.) Do you consider that the class of observations (defined in your answer to my question 2) are such as can be efficiently made in an observatory maintained by the State, or that any of them would be better left to the zeal of volunteer astronomers?"

"[Addressed to M. Faye only.]

"(5.) Do you consider that it would be advantageous to carry on Physico-Astronomical researches on an extensive scale, and Meridional observations, in one and the same observatory, under a single director?"

Sir W. Thomson:—

* * * * * * * *

"The subject of investigation in any observatory for Astronomical Physics is so very different from that for which the great Astronomical observatories at present existing were founded, that I believe generally it would not be good economy of resources to attempt to adapt the old observatories to the new investigations. The instruments adapted for accurately determining the positions of the heavenly bodies, which constitute the most important part of the great observatories hitherto established, are scarcely adapted to give any contribution towards Astronomical Physics. New instruments designed for the work of the spectroscope, and new buildings to contain them, are necessary. A chemical laboratory, and an extensive system of galvanic batteries and electro-magnetic apparatus are required for the new kind of Astronomical observatory. I doubt very much whether one man could act effectively as executive chief of an observatory of Astronomical Physics, and at the same time of an observatory of the old kind."

Professor Hilgard:

"(1.) That the systematic study of the sun's constitution is likely to throw light on subjects of terrestrial physics, I would unhesitatingly affirm; yet without expressing the belief that the minor meteoric or magnetic variations are dependent on changes taking place in the sun.

"(2.) The available means for studying the sun at present known to science are, in my apprehension, in addition to observations made with the eye, solar photography, photometric and calorimetric observations, and spectroscopic observations, combined with laboratory experiments necessary for the interpretation of the latter.

"(3.) I do not think that photography alone will suffice for the purpose indicated, since it will give little else than a registration of solar spots, the study of which by means of the spectroscope appears to be also of prime importance.

"(4.) I perceive no difficulty in organizing the several classes of observations above mentioned systematically, so as to be efficiently made in an observatory maintained by the State. Similar considerations to those upon which the maintenance of meteorological and magnetical observations is based, would warrant a provision for systematic observation of the sun.

"The value of the latter, as of the former classes of observations, largely depends upon their regular continuity, which cannot be expected from the zeal of volunteer observers, who must look for their reward to results of immediate interest."

* * * * * * * *

Dr. Balfour Stewart:

"In reply to your first question, I cannot help thinking that a study of the solar constitution is likely to throw light on the subjects of Terrestrial Physics, such as Meteorology and Magnetism. My reasons are:—

"(1.) That I consider the *fact* of a connexion between sun spot activity and disturbances of the earth's magnetism to be very well proved, although we are ignorant of the *nature* of the connexion.

"(2.) The recent researches of Mr. Baxendell, Mr. Stone, Professor C. P. Smyth, and others, render it extremely probable that there is likewise a connexion between the period of solar activity and the meteorology of our globe.

"(3.) The recent researches of Messrs. Warren De La Rue, Stewart, and Loewy, as well as those of Professor Wolf, render it very probable that there is a connexion between the positions of the chief planets and the behaviour of sun spots.

"(4.) The recent observations of Messrs. Browning and others render probable a connexion between the appearance of the planet Jupiter and the state of the solar disc.

"I think that all these, taken together, can leave us in little doubt of our duty with regard to solar observations. If we were not only perfectly sure of a connexion, but likewise knew all about the nature of this connexion, the necessity of studying the sun would yet be as strong as that of recording the positions of the various planets with the view of verifying the law of gravitation. But inasmuch as here the nature of the connexion is unknown, it is of imperious necessity to study the sun with the view of accumulating a sufficient number of good observations which may ultimately enable us to determine the nature of this unknown connexion.

"We ought to remember how greatly the accurate observations of Tycho Brahe contributed to the generalizations of Kepler.

* * * * * * * *

"In reply to your second question, I would enumerate the following means of observation of the sun:—

"(1.) Eye observations through a telescope.
"(2.) Photography.
"(3.) Spectroscopic observations.
"(4.) Actinic observations.

* * * * * * * *

"In reply to your third question, I do not consider Photography sufficient for the purpose. I think that eye observations, more particularly when combined with the spectroscope, are essential to enable us to know what is going on in the sun from minute to minute, and unless we know this, I do not well see that we are ever likely to arrive at a true theory of solar disturbances, or of the connexion between these and the disturbances of the meteorology and magnetism of the earth. Could we ever have ascertained the velocity of the solar currents without the aid of the spectroscope?

"As a self-recording instrument for registering the actinic effect of the solar rays has been perfected by Dr. Roscoe, and as it is a point of importance to study the influence of the solar rays upon vegetation, I think that whenever the sun's surface is regularly studied, actinic observations ought, from this cause as well as from their physical importance, to be included among the duties of the observatory.

"In reply to your fourth question, believing that a long continued and systematic series of observations is beyond the means of volunteers, I think that the four kinds of observation of the solar surface which I have specified ought to be made in an observatory maintained by the State. Indeed, for some of them more than one observatory would be requisite, for I think it an object of great importance to obtain a daily record not only of the position but of the area of every group of spots which appears on the surface of the sun. But to obtain this more than one observatory would be necessary, for we must be independent of the influence of weather; and to be so we must have stations so distributed that when it rained at one station it might reasonably be expected to be fair at another.

* * * * * * * *

"I think that the study of the sun ought to be systematically conducted in an institution for the purpose working under Government, and connected with a number of stations sufficient to ensure a good record of what takes place on the solar surface, independent of the influence of weather.

"It appears to me also that such an institution should have a laboratory as well as a workshop connected with it."

* * * * * * * *

M. Faye:

"1. L'étude de la constitution physique du soleil ne me paraît pas appelée à répandre de grande lumière sur la Physique Terrestre, c'est-à-dire sur la Météorologie et le Magnétisme. L'action solaire est actuellement caractérisée par une constance bien remarquable, sauf de petites variations accidentelles ou périodiques de peu d'importance. L'étude directe de ces divers sujets de Physique Terrestre suffit amplement. Mais il en est autrement des âges géologiques dont l'histoire me paraît liée intimement à des changements progressifs d'ont on reconnait la possibilité dans l'activité interne du soleil.

"Toutefois on ne peut nier que les recherches nouvelles qui ont eu pour but de rattacher certaines périodes dans les phénomènes magnétiques aux phénomènes également périodiques du soleil ne méritent intérêt et considération.

"2. Les moyens dont nous disposons aujourd'hui pour l'étude du soleil sont au nombre de huit:—

"1°. Étude des mouvements de la photosphère par les taches et les facules. (Carrington.)

"2°. Étude de la constitution chimique de la photosphère et de la chromosphère. Variations, plus ou moins rapides, de cette constitution. Analyse chimique continuelle de la superficie solaire.

"3°. Étude des mouvements de la chromosphère, éruptions, protuberances, etc. Distribution de ces phénomènes selon la latitude.

"4°. Étude des variations périodiques de la surface, par les precédés de Schwabe et ceux de l'Observatoire de Kew.

"5°. Étude des éclipses totales, auréole, couronne, etc., au moyen d'expéditions lointaines.
"6°. Études des changements séculaires de l'activité solaire au moyen des données de la géologie.
"7°. Étude analogique du soleil au moyen de l'observation des étoiles variables ou nouvelles.
"8°. Application de la mécanique moderne à l'étude des mouvements internes qu'on peut supposer dans la masse solaire.

"3. Le moyen le meilleur d'étudier les mouvements des taches et des facules est incontestablement la photographie. C'est surtout par là qu'on peut espérer de rencontrer des phénomènes auxquels s'appliqueront tôt ou tard les lois de la mécanique. Mais ce n'est là qu'une face de la question. La spectroscopie n'est pas moin indispensable. C'est par elle que la physique et la chimie peuvent s'appliquer aux études solaires auss bien que la mécanique. Réduire cette étude à la photographie ce serait se condamner à ne voir qu'une face de la question. Je ne veux pas que cette opinion puisse être sérieusement soutenue.

"4. Il suffit d'envisager l'importance du but des études solaires et la variété du moyen d'action que la science moderne nous présente pour penser que le moment est venu de confier les études à un ou plusieurs établissements pourvu de grandes ressources, et pouvant fonctionner avec continuité pendant un laps de temps illimité.

"Sans doute on devra compter sur le concours puissant des volontaires de la science. Mais le concours se présente toujours avec des restrictions quant aux ressources, à la continuité, et à la durée, lesquelles me paraîssent peu compatibles avec les résultats à obtenir.

"5. Je suis d'avis que les études doivent être poursuivies dans des établissements spéciaux; que leur introduction dans les observatoires astronomiques serait nuisible à l'astronomie proprement dite, sans pouvoir donner tous les résultats que procurerait une division bien nette du travail. L'expérience que nous en avons en France me paraît décisive."

* * * * * * * *

Evidence relating to Meteorology.

For the reasons which have already been stated, we have taken a considerable amount of Evidence with reference to the Meteorological Observations at present carried on in the United Kingdom, whether at the cost of the Government, or of Societies or Private Observers. To some points in this Evidence we think it necessary to call attention: of these the most important are those which relate to the Meteorological Office.

This Office is under the Management of the Meteorological Committee of the Royal Society, the Functions of which are thus described in the Report annually presented to Parliament:—

"The Meteorological Committee consists of Fellows of the Royal Society who were nominated by its President and Council, at the request of the Board of Trade, for the purpose of superintending the Meteorological duties formerly undertaken by a Government Department, under the charge of Admiral FitzRoy. Preface to Report for 1872.

"The Committee are credited with a sum of 10,000*l.* voted annually in the Estimates, for the administration of which they are wholly responsible, and over which they are given the entire control.

"The Meetings of the Committee are held once a fortnight, or oftener when necessary, when every subject on which action has to be taken by their executive officers receives their careful consideration. The duties of the Committee are onerous, and *entirely gratuitous;* they were accepted, and are very willingly performed by the members, on account of the earnest desire they severally feel for the improvement of Meteorological Science."

The position of the Committee is anomalous. In the words of the Director of the Meteorological Office—

"The Government distinctly disclaims all connexion with us, whilst the Royal Society equally disclaims all control over us, except merely the nomination of the members of the Committee." Qu. 13,867

"As a matter of fact, all that the Royal Society does is to nominate the members of the Committee?—That is all." Qu. 13,868

"Having so done, it ceases to have any control whatever, does it not?—Entirely." Qu. 13,869.

"What is the precise relation between the Office and the Government?—That the Government gives a vote of 10,000*l.* every year, and that it calls for no account of this money, excepting the account annually presented to Parliament." Qu. 13,871.

"Who audits the accounts?—The members of the Committee. There is no formal audit, because, as the Government would not recognize any audit excepting its own, the Committee considered that it was not worth while paying an auditor if such audit would not be recognized, and, as a matter of fact, two of the members take the trouble of auditing the accounts every year." Qu. 13,872.

"What, in your opinion, are the chief advantages and disadvantages of such an arrangement as compared with those of the direct management of the Office by the Government?—The chief advantage is the perfect freedom from political management. The risk in being connected with the Government is that if a new President of the Board of Trade comes, he may reverse the action of the preceding one. The existence of a scientific supervision for the Office is exceedingly important; it acts as an intermediate party between the public and the Office. I may mention a decided disadvantage which results from the Office not being connected with the Government, namely, the loss of *prestige.* The difficulty is, that if we are sending instruments by sea or by railroad, if we do not call them Government instruments we cannot get as much attention paid to them, and it is my opinion that we should get more co-operation from the merchant navy if we were an office of the Board of Trade. We should have more *prestige* as acting directly from the Government." Qu. 13,873.

The following very clear account of the objects which the Meteorological Committee propose to themselves is taken from the Evidence of Major-General Strachey, one of the Members:—

"I would, then, state generally what I understand to be the objects which the Meteorological Committee Qu. 14,212.

Qu. 14,212. has to superintend. These are, first, the collection of meteorological data from ships' logs, with a view to the preparation of maps for the use of sailors, showing the probable, or it may be termed the average, meteorological elements all over the ocean, on the chief line of trade routes, for the several months in the year. Included with these is the investigation of the ocean currents. This branch of duties is carried on under Captain Toynbee. The second branch of the business is the collection and daily publication of meteorological observations made on the British Isles and neighbouring coasts, extending from the coasts of Scandinavia to France, and partly to Spain. Although at the outset of the issue of warnings as to probable bad weather was not contemplated, yet after the Committee had been in operation for a few months it was considered desirable again to undertake this, and in the first year of the Committee's existence the issue of warnings of anticipated stormy weather was resumed. I daresay Mr. Scott has told the Commissioners, that within the last few months there has been a little more detail given in the warnings. Originally they were mere warnings that stormy weather was likely to occur. Now there is a statement also given of the probable direction from which the wind is to come, and whether it will be of extreme force. The third of the objects is the recording at certain specially-organised observatories, seven in number, maintained under the direction of the Committee, of the principal meteorological elements, with self-recording instruments; with the intention of obtaining a continuous record with as great accuracy and precision as possible, and thus of procuring accurate data for the scientific study of meteorology by all persons who are interested in that science. I should add that the Committee has, within the last month or two, from the commencement of this year in fact, begun to print and to issue monthly the detailed observations made at these seven observatories. The Committee also publishes quarterly reports, which contain diagrams embodying the observations at the seven observatories, and an analysis of the weather over the British Isles, of which the details are furnished in the daily reports. There is no doubt that the publication of those quarterly reports is an useful addition to the daily reports, which are extremely voluminous, and not very easy for persons to follow who do not devote themselves to the subject. The last of the specific duties of the Committee is the supply of meteorological instruments for the Royal Navy and Mercantile Marine. Besides various miscellaneous references come from the Board of Trade, to which, of course, the Committee gives such answers as it is capable of doing."

It is admitted that the objects thus described do not exhaust the whole of Meteorology, and that the Committee in their selection of these objects have been, to a great extent, guided by the proceedings of the Meteorological Department of the Board of Trade, which existed prior to, and which has been superseded by the Committee. Thus Major-General Strachey says:—

Qu. 14,215. "The Committee is now in reality doing no more than continuing the exercise of certain functions which had, in the course of time, been thrown upon the Board of Trade by the position which that Department occupies in connexion with the public administration."

Qu. 14,216. "Has the consequence been that the action of the Committee has been from the outset rather in a practical direction than in one of original research or scientific observation, properly so called?—I think distinctly that such is the case, and that it has necessarily followed from the position in which the Committee was placed. If a reference is made to the earlier papers, and to the Report of the gentlemen on whose suggestions the present arrangements originated, there perhaps is an indication that they anticipated something more in the way of scientific research than has actually occurred; but the turn that things have taken seems to me the necessary result of the sort of duties that were put upon the Committee under the essential condition that it had but a limited sum of money to spend."

Qu. 14,217. "Have any results of scientific importance in your opinion been obtained by the action of the Committee?—In the direction of what one may call investigation of an absolutely scientific character, I should say none at all. Of course the observations that are made at the special observatories are valuable scientific information, and so far one has no right to say that scientific results have not been produced; but I do not think that these can properly be referred to as specific results of anything that the Committee has done. To the best of my belief there has been nothing undertaken in the way of original investigation into the specific physical causes of any of the phenomena which are recorded, nor any original research, properly so called, in relation to any of the several branches of meteorology. The Committee hardly has appliances at its command for any such investigations, and, the funds at its disposal being limited, it was hardly possible that it should attempt them. It is also no doubt quite true that the observations which are made at the seven observatories do not include any matters which are of great importance in physical science, and which would properly come within the range of meteorology."

Qu. 14,218. "Are the funds at the disposal of the Committee in your opinion insufficient for doing anything more than has been actually done at present?—I should say distinctly that this is the case. The Committee has always considered that it is bound to attend primarily to the special objects before referred to, which were in a specific manner made over to it, and it finds that after this has been done there is no money left for other things."

Again, the same Witness expresses a decided opinion that the State should do more for the promotion of Meteorological Science than it does at present, but entertains some doubt whether any increased duties could advantageously be allowed to devolve upon a body such as the Meteorological Committee:—

Qu. 14,226. "Can you state the directions in which you think the State should intervene?—This seems to me an extremely difficult question to answer. The fact is that the form in which the State might in a satisfactory way intervene must depend upon the extent to which it is disposed to intervene. If one knew that the Government really desired to assist in the development of scientific meteorology, it would be possible to make a scheme, but I do not see how anybody could make what I may call an abstract plan which should have any real utility in it. My own impression is that so long as there is no greater interest taken in this sort of matter than at present, probably the best thing to do is to leave the expenditure of what money the Government choose to give for the purpose under the control of some such body as our Committee; but I should further say that if the Government is seriously in earnest in taking the matter up, it would then be the proper thing to have a public department that should manage the business. Then again, if there were a public department, it must be a part of an organised system; and in order to secure an efficient public department to supervise such matters, it seems to me that it would be necessary to have some officer connected directly with the Government, an Under-Secretary of State, or some such person, who should be responsible that the executive scientific staff properly carried out the whole of the operations of their several departments."

Qu. 14,285. "Are you disposed to think that the Meteorological Committee might in any way extend its sphere of action with advantage?—As matters are now I should think it is extremely doubtful. I look upon the Meteorological Committee as being mainly a controlling body to supervise the expenditure of a definite sum of money in a definite way. At all events that practically has been their position. There has been no virtual change from the time that they were started up to the present time."

Qu. 14,286. "Do you think that that money would be spent better in some other way; that is to say, supposing the thing had to be started afresh, are those objects which the Committee at present have to carry out exactly those that you would have given them to carry out?—I should say in general terms that the whole of the objects which the Committee has charge of are reasonable objects. I do not think that there is any one of them that it is not desirable to attend to. As to whether the precise method of dealing with them is the best possible will be a matter of opinion, but I do not think that I could very usefully go into that."

Qu. 14,287. "Does it occur to you that there is anything else which should be added to the functions of the Committee?—My general impression, as I implied before, is that the Committee is a quasifinancial body having certain scientific knowledge. Its duty is not strictly speaking to direct scientific research or scientific operations, but it is to see that a certain sum of money which the Government thinks may reasonably be applied to collecting and publishing meteorological observations, and doing certain other matters, is not unreasonably applied. It exercises a check upon the persons who have actually to carry out those duties, as I understand it; and I do not think myself that, with a body constituted as the Meteorological Committtee is, you can expect more from it than that."

Qu. 14,288. "Do you think it would be desirable that the Committee should be entrusted with money to enable it to have any observations collected, scientifically discussed, and turned to scientific use?—I think it would be much better if any such fund were not given to a body like the Committee. If some individual were selected, and the entire responsibility put upon him, I think it would be a much better plan."

Qu. 14,289. "You want to do away with the Committee altogether?—I think so, certainly; supposing always that I am at liberty to replace it according to my own conceptions of what is best."

The same view is expressed by Professor Balfour Stewart—

Qu. 14,035. "Would you organize the Meteorological Committee in any really different form to that which at present obtains?—I should be inclined to dispense with the Meteorological Committee altogether, and substitute a Meteorologist Royal, or whatever his appellation might be, a single official who should be responsible to the Government in the same way as the Astronomer Royal is responsible for his department. I do not see why the one department should be on one footing and the other department on a different footing. I think that there are grave disadvantages with a department administered by an unpaid committee."

Qu. 14,036. "Would you appoint a Meteorologist Royal corresponding with the Astronomer Royal?—Yes, whatever the name might be; I should appoint an official very much corresponding to the Astronomer Royal and responsible to the same extent. A board of visitors would not be objectionable, but the direction of an unpaid committee appears to me to be very objectionable."

The same Witness considers that the subject of Meteorology naturally divides itself
into two heads, (1), Physical Meteorology, of which "the object would be to ascer- Qu. 14,031.
tain the Physics of the earth's atmosphere, and perhaps of the earth's ocean," and
which must consequently be regarded as a branch of Terrestrial Physics; and (2), Local
or Climatic Meteorology, involving a number of Inquiries having special relation to
Health, Agriculture, and various Human Interests. The distinction is one which perhaps
does not admit of being very closely pressed. For example, it is not clear to which of
the two heads the Observations upon Rain-fall should be referred; not to mention that
any series of Meteorological Observations, with whatever object undertaken, must Qu. 14,059.
have a special value with reference to the Locality at which they are made. Professor
Stewart is further of opinion that while Physical Meteorology should receive even larger
support from Government that it does at present, Climatic Meteorology might in the
main be left to voluntary and local exertions.

Qu. 14,037. "Would you leave the other branch of the subject, climatic meteorology, to individuals and local efforts?—Yes, I think so, possibly supported to some extent by funds from the Government, but I should not put such branches under the superintendence of a central board at the present moment."

And again,—

Qu. 14,045. "Would you leave climatic meteorology altogether to societies and to individual effort?—At the present moment it appears to me to be a matter that might best be left in that position, and that a central authority would do no good in a question of this kind, but rather do harm; in fact, rather tend to depress than to encourage these local efforts. I have no doubt that a great deal might be done by the zeal of local individuals, but if the thing were undertaken in its present state by a central board, which would do little but register a number of observations, I do not think that any good would at the present moment be done."

Such aid as Government might give to Climatic Meteorology, should, in the opinion
of the Professor, rather take the form of Grants to Societies, than of any extension, Qu. 14,047.
in this direction, of the Functions of the Meteorological Office, for the double reason
that it would be undesirable to discourage local efforts, and to dissipate the energies
of the Meteorological Office by diverting them from Physical Meteorology.

Qu. 14,039. "As far as the money is concerned, I consider that a mere matter of detail, but I should be very strongly against the Meteorological Committee undertaking anything but Physical Meteorology; I think that they ought to confine their labours to that. If they at present undertake all those branches of meteorology bearing upon the various individual human interests, it appears to me that you will leave them no energy to attack the problems of physical meteorology. I think the great point is to put physical meteorology somewhat more into the position of a branch of physical science; at the present moment it appears to me to occupy a very low position indeed."

It appears that within the last two or three years the Meteorological Committee have made great efforts to extend their work in such directions as might be most likely to help in the promotion of Scientific Meteorology. Thus, they have commenced publishing the individual values derived from their self-recording instruments; Qu. 14,436. and they have undertaken regular Observations upon Atmospheric Electricity. But the efforts of the Committee to extend their operations are limited by insufficiency of funds.

Qu. 14,438. "Is there a want of funds for a more complete treatment of the subject of land meteorology?—A very serious want of funds. As I mentioned before, for any serious discussion like that of the hourly values for all the elements for five years we are not provided with a sufficiency of funds; in fact the amount of our staff for land meteorology would be sufficient to discuss the results for one observatory, but not for seven. It is in that sort of way that the original provision of clerks who were to discuss the work was quite insufficient, the amount of materials being so enormous."

Mr. Scott also informs us that:—

Qu. 13,925. Supplementary Evidence. "Arrangements have been concluded between the Meteorological Society and the Meteorological Office, and have come into effect on the 1st January 1875. The principal features of these arrangements are that the Observers belonging to these two organizations are supplied with an uniform schedule for recording their observations, and that the Society undertakes to furnish to the Office monthly returns from certain selected stations for publication with the returns from its own stations, in consideration of a certain payment, which will probably average about 50*l.* per annum."

"An invitation has been issued to the Scottish Meteorological Society to co-operate with the Office on similar terms, and the Meteorological Committee are not without some hope that this proposal may be accepted."

Besides the sum of 10,000*l.* which is placed on the Civil Service Estimates and is annually paid to the Meteorological Committee, the Government incurs a certain expenditure on account of Meteorology at the two National Observatories of Greenwich and Edinburgh. This expenditure for the year 1874–75 amounted to 1,221*l.* for Greenwich, and 115*l.* for Edinburgh.

A further small annual payment of 150*l.* is made by the Registrar General for the Reports of Meteorological Observations which are printed in his Monthly Returns. These Reports are supplied by Mr. Glaisher, the observations being made at different stations in various parts of England, by unpaid private observers, whose co-operation Mr. Glaisher has been able to obtain. The Evidence shows that the work is done under regulations which are sufficient to ensure its general accuracy; and it is obvious that the annual payment of 150*l.* hardly covers the expenses incurred, and affords no remuneration for the trouble taken in organizing and controlling the System of Observations.

Evidence relating to Tidal Observations.

Evidence in reference to Tidal Observations has been placed before us by Dr. Joule and Professor Sir W. Thomson.

Dr. Joule is of opinion that—

Qu. 10,568. "With regard to the sea level and the tides, although the laws with regard to the tides are pretty well known, they ought to be continuously observed, if only for the purpose of registering the changes arising from the alteration of banks, depth of channels, &c. Also with regard to the sea level, there have been reports from time to time with regard to the inroads of the sea on our coasts, but sufficient steps do not appear to have been taken to ascertain the facts in those cases. It seems to me very important to be acquainted with any alterations in the configuration of the earth which may be taking place, however minute those alterations may be."

He thus expresses his views as to the manner in which these Inquiries may be carried on:

Qu. 10,576. "Would that be a work which ought, in your opinion, to be carried on from day to day by a permanent establishment at such places?" "I believe that self-registering apparatus have been devised which would enable the mean sea level to be registered, and the tides to be registered, without very much trouble."

Qu. 10,577. "Is it a sort of work which can be carried on by public officers stationed at any of the ports, or would you require a separate staff?" "Probably it might be carried on by the officers at the stations. I do not think it would be necessary for anyone to be exclusively occupied in such a work."

Sir W. Thomson's Evidence on this point is as follows:

Qu. 10,715. "In addition to those institutions which you have recommended, you consider, do you not, that it would be advisable that the Government should undertake secular observations of the tides?" "Yes, certainly, secular observations of the tides with accurate self-registering tide gauges, with the triple object of investigating the science of the tides, of perfecting our knowledge of the actual phenomena of the tides, both in respect to navigation and as a branch of natural history, and, thirdly, with a view to ascertaining the changes of the sea level from century to century."

Qu. 10,716. "Is anything of the kind done at present?" "There are several tide gauges, some of which have been carried on with great care, others with not sufficient care, and none with any security of permanance."

Qu. 10,719. "Was not it in connexion with the Ordnance Survey of Great Britain?—No sufficient steps have been taken to ascertain whether the sea level is changing relatively to the land in any part of this country."

Qu. 10,720. "Would you think a large number of stations requisite for the observations of the tides to which you have alluded?—Yes, a large number. The phenomena of the tides are of great complexity, but not of baffling complexity, provided that we make the observations at a sufficiently great number of points."

Qu. 10,721. "Would the duties attached to such observations take up the whole time of the persons who had charge of them?—By no means. They could undertake other duties. A tide gauge may be put under the hands of a careful harbour master or officer of the coastguard service at any station, but it must be under inspection to secure accuracy. The most careful and scrupulous of such men cannot make sure that the instrument is giving accurate results; and they cannot, except under instruction and occasional inspection, give out recorded curves, that they can be quite sure of being accurate in all points of scientific nicety; but the inspection that is required to secure accurate results would be a very simple and moderate matter."

The accurate Reduction of Tidal Observations, without which, of course, they are useless, has not hitherto been undertaken by any Department of the State, and we are indebted to the zeal of individuals for the results which have been obtained. The reductions are laborious, and require the employment of paid computers. The following Memorial from the British Association for the Advancement of Science to the Lords Commissioners of the Treasury, put in evidence by Sir William Thomson, shows the difficulty that has been felt in procuring the moderate sum required for the Reductions:—

"MEMORIAL to the Right Honourable the LORDS COMMISSIONERS of HER MAJESTY'S TREASURY. Appendix i

"The Memorial of the British Association for the Advancement of Science. Vol. II., p.3

"Humbly sheweth,—

"1. That in the year 1867 the British Association appointed a Committee 'for the purpose of promoting the extension, improvement, and harmonic analysis of tidal observations.' From that time until the present, under committees reappointed from year to year, the proposed work has been carried on. The mode of procedure adopted, and the results obtained up to the month of August 1871, are fully stated in the accompanying series of printed reports.

"2. The primary object of this investigation is the advance of tidal science, but the Committee have uniformly kept in view the practical application of their results to Physical Geography, Meteorology, Coast and Harbour Engineering, and Navigation.

"3. A large mass of valuable observations, recorded by self-registering tide gauges during the last 20 years, having been found available, the Committee have applied themselves, in the first place, to the reduction of these observations, and have deferred the object of promoting observations in other localities until the observations already made have been utilized to the utmost.

"4. The work thus undertaken has proved, as was anticipated, most laborious. The calculations have been performed, under the superintendence of Sir William Thomson, by skilled calculators recommended by the Nautical Almanac Office. The funds required to pay the calculators, and to print and prepare tables, forms for calculations, &c. to the amount of 600*l.*, have been granted by the British Association in four successive annual allowances of 100*l.* each, and a sum of 200*l.* voted at the last meeting. The last grant barely sufficed for the work actually in hand, and to secure the continuance of the investigation additional funds are necessary. The Council of the British Association, therefore, directed the Tidal Committee to make an application to the Government for assistance, the amount at present asked for being limited to 150*l.*

"5. It seemed to the Council that after the Association had done so much in the way of actual expenditure of time by the members of its Committee, and had given such a large contribution from its very limited funds, enough had been done to show the object to be one for which assistance may reasonably be expected from Government. On representations made by Colonel Walker, Director of the Trigonometrical Survey of India, the Indian Government has already granted the means of defraying the expense of making tidal observations in India, and applying to them the methods of reduction devised by the Committee of the British Association. The Council hope, therefore, that the Government of this country may be similarly diposed to assist in a matter of national importance.

"(Signed) WILLIAM THOMSON,
"May 21, 1872. President of the British Association."

The Lords Commissioners of the Treasury did not accede to the Prayer of the Memorial, so that, at present, there is no guarantee that the Observations which have already been accumulated, and those which are still in progress, will ever be adequately discussed and utilized.

Evidence relating to the Extension of the Government Grant administered by the Royal Society.

The strong and concurrent Evidence which we have received as to the usefulness of the Government Grant, as at present administered by a Committee of the Royal Society, has led us to inquire whether this Grant might not be advantageously extended; and the Witnesses whom we have examined on this point are unanimous in expressing the opinion that great benefits might be expected from such an extension.

Qu. 11,570. Thus, to the Question, "Have you formed any opinion as to whether it would be "desirable that the Government Grant of 1,000*l.* a year, placed at the disposal of the "Council of the Royal Society, should be increased or not?" Professor Owen replies: "It has been so admirably applied and with such gain to Science, that there cannot be "a doubt that it would be a great benefit to Science if it were doubled to begin with."

Qu. 11,995. Mr. Spottiswoode, the present Treasurer of the Fund, states his opinion that an extension of the Government Grant would be desirable, and expects that the minimum which might be voted every year would increase materially.

Qu. 12,214. Professor Grant gives his opinion "that it is very desirable that the grant should be enlarged." He also considers that it "would be expedient that wider publicity should "be given to the fact of its being generally available to persons engaged in scientific "investigations."

Qu. 13,135. Mr. De La Rue is of opinion "that it is administered exceedingly well and very carefully." He considers that the amount should be increased.

Qu. 13,590. From the Evidence given on page 13, it appears that Lord Salisbury also is of opinion that the Government Grant might be increased, with the object of affording liberal assistance to "first-rate workers."

Appendix XIV., Vol. II., p. *67*. In a Memorial presented to us by the Royal Society of Edinburgh, it is recommended that a corresponding Grant be placed at the disposal of that Body, for the Promotion of Science in Scotland. The claims of Scientific Workers in Scotland to participate in the Grant equally with those in other parts of the United Kingdom, have been fully recognised, and we think it of importance that there should be but one such Grant for the whole of the United Kingdom and one body responsible for its administration. In the measure hereinafter recommended we have suggested that the Administration of future Grants should be assigned to a Council of Science which should include the Representatives of the Scientific Societies of the United Kingdom.

Evidence as to the Payment of Scientific Workers.

On this branch of our Inquiry, the Evidence laid before us, both by Statesmen and men of Science, is to the same effect, and in favour of increased State Aid. It has also especially been urged upon us, that to afford, by direct pecuniary aid, the means of livelihood to men of distinction in pure investigation would be a great advantage to science, as competent investigators would thus be enabled and encouraged to pursue a strictly Scientific Career.

Qu. 13,553. Lord Salisbury is of opinion that the cause of Science is hindered by the want of a sufficient career for scientific men, giving the following statement of his reasons:

> "I am induced to think so, by noticing how very much more rapid the progress of research is where there is a commercial value attached to the results of it, than in other cases. The peculiar stimulus which has been given to electrical research, in the particular direction of those parts of it which concern the telegraph, is a very good instance in point, and the extent to which researches into organic chemistry have almost clustered themselves round the production of coal tar colours is another instance in point. And therefore it is difficult to avoid the conclusion that research is really hindered by the necessity under which those who are most competent to conduct it feel themselves, of providing for their own support by means of the talent and the knowledge which they possess."

Qu. 13,523. Lord Derby takes the same view:—

> "I think that, in one way or another, where you have a man of very great eminence as a scientific discoverer, it is unquestionably the duty of the State to provide him with means and leisure to carry on his work. Whether that is to be done by giving him an office under the British Museum, or in any similar institution, or whether it is to be done by simply granting him a pension in recognition of eminent scientific service, or in whatever other way it is done, it seems to me to be immaterial, but I certainly consider that it is a very important part of the public duty, to relieve men who have shown an eminent capacity for original discovery and research from the necessity of engaging in a lower kind of work as a means of livelihood." * * * *

Qu. 10,736. Sir W. Thomson, in a reply to which we have already referred, stated his opinion on this point as follows:

> "That men should be enabled to live on scientific research is a matter of most immediate consequence to the honour and welfare of this country. At present a man cannot live on scientific research. If he aspires to devote himself to it he must cast about for a means of supporting himself, and the only generally accepted possibility of being able to support himself is by teaching, and to secure even a very small income, barely sufficient to live upon, by teaching, involves the expenditure of almost his whole time upon it in most situations, so that at present it is really only in intervals of hard work in professions that men not of independent means in this country can apply themselves at all to scientific research." * * * *

Professor Henry, the distinguished Director of the Smithsonian Institution in the United States, who was good enough to appear before us when he was in this country, gave the following emphatic evidence in the same direction :—

> Qu. 1520. "My idea would be that if the funds were sufficient, and men could be found capable of advancing science, they should be consecrated to science, and be provided with the means of living above all care for physical wants, and supplied with all the implements necessary to investigation."

Qu. 11,419. Qu. 11,420. Professor Balfour Stewart, after referring to the instances of wealthy persons who undertake Scientific Research in this country, points out that the number of those so circumstanced is very small in comparison with the number of able men who are willing to give their time and capacities to Observations and Research. He goes on to say that able men, and men competent to conduct research, suffer in this country from not having sufficient means at their disposal to proceed as they would like to do.

> Qu. 11,421. "Do you anticipate, then, that if there were any intelligent centre for the distribution of a sufficient fund to persons having the requisite capacities for observation and research, but not having the means, the distribution of such a fund would have any benumbing influence upon original observation and research?"—"No, I should think quite the contrary; it would encourage it very much."

Qu. 10,902. Mr. Gore also advocates the enlargement of the present system.

> ". . . . I should strongly advocate that the present system should be enlarged, so that the investigators should not merely be reimbursed for all that they have expended, but also paid in some measure for their time and labour, because each investigator has to give up a profitable employment in order to find the time."

He then gives his own personal experience, which probably resembles that of many of those who, without private fortune, engage in pure research.

> Qu. 10,902. "I refuse a great many engagements in analyses and other scientific matters for the manufacturers who come to me. * * * I gave up some pupils a short time ago to enable me to have more time for original investigation."

Some of the Witnesses seem to have considered the Pecuniary Aid which they think should be afforded, more in the light of Rewards for work done than as an Aid to work to be done. Thus, Dr. Joule, is of opinion—

> Qu. 10,654. "That a small sum of money in recognition of scientific labour would be in many cases a most useful help as well as a great encouragement, and if the Patent Laws are retained they might be supplemented with provisions to meet the case of those discoveries to which the Patent Laws do not apply."

Qu. 11,771. Dr. Siemens is of opinion that the Government might promote original research by liberal grants to the Learned Societies; remarking that this is done now to some extent, but might be done with advantage to a greater extent.

Qu. 11,771 He then suggests that the Government might also encourage Scientific Research "by granting through Societies, rewards for successful results obtained by independent research. In many instances the Patent Law provides for the reward, but in other cases of pure science the Patent Law does not apply, and the results of original research are left unrewarded."

Qu. 13,054. Mr. De La Rue is of opinion that if men are not in a position of fortune to continue their researches, in some cases materials and even money might be granted to them.

Qu. 13,094. Qu. 13,095. Referring to the extent and value of the Original Researches in Chemistry carried on in Germany, he ascribes them "to the care which is given to the cultivation of every branch of science; and moreover to the positions and places at the disposal of the Government which are given from time to time to men who render themselves eminent in Science."

With regard to the Scale on which such Remuneration or Payments for Maintenance should be made, Lord Salisbury observes :—

> Qu. 13,569. "I should say, taking the parallel [that of certain offices in the Church], to which I have already alluded, that an income of about 1,000*l.* or 1,500*l.* a year would be the kind of income which would suffice for the purpose that I have in view."

And he would also add Provision for Retirement.

Qu. 13,568. With reference to the safeguards against abuse which would be necessary, Lord Salisbury continues :—

> Qu. 13,567. * * * "It would, for their [the investigators'] own interest, and to save them from invidious comments, be desirable, to impose upon them the necessity of publishing, either in the form of books or in the form of lectures (but not sufficient in number really to impede their work), an account of the result of their labours during each successive year. Perhaps one or two stated lectures in the course of a year, to be delivered to University students, would be the best means of imposing upon them that test of industry."

Lord Salisbury further recommends that aid of this kind should be given directly and with as little concealment by ostensible duties of another kind as possible; adding:

> u. 13,560. * * * "If any money is to be given, as I think it ought to be given, for the purpose of furnishing a career to men who are really engaged in research which is not pecuniarily profitable, I think that it would be far better given directly and openly than given under the form of an office which would practically be a sinecure."

In contrast with this view, that the endowment should be given directly, we think it right to quote the opinion of the late Professor Rankine:—

> u. 9515. "I think there is no general principle, but every case must be judged of on its own merits. The other thing which is wanted, besides money, is the leisure time of competent persons. It seems to me that it is out of the question for any State to provide or endow such a set of persons, and that it would be impossible for any department of the Government, either to judge who were fit persons, or how they ought to be employed, or what would be a proper remuneration for them. And I believe that if any such system were instituted, it would only lead to abuse. Setting aside such leisure time as men may have who are of independent fortune, and do not require to practise any profession or special occupation, I would say that it appears to me that in order to ensure that other competent persons shall have the requisite leisure, it is desirable that there should be offices with other functions attached to them, but those functions should be of such a nature that the holder of the office may have leisure time for original research." * * *

REMARKS ON THE FOREGOING EVIDENCE.

The great advances in Physical Science which have been made in this Country, and within this century, by such men as Dalton, Davy, and Faraday, without aid from the State; the existence of our numerous Learned Societies; and the devotion of some few rich individuals to the current work of Science; at first sight appear to reduce the limits within which State Aid to Research is required in this country.

But whilst we have reason to be proud of the contributions of some great Englishmen to our Knowledge of the Laws of Nature, it must be admitted that at the present day Scientific Investigation is carried on abroad to an extent and with a completeness of organization to which this country can offer no parallel. The work done in this country by private individuals, although of great value, is small when compared with that which is needed in the interests of Science; and the efforts of the Learned Societies, not excepting the Royal Society, are directed to the Discussion and Publication of the Scientific Facts brought under their notice; these Societies do not consider it any part of their corporate functions to undertake or conduct Research.

It will have been seen, from the extracts from the Evidence, that amongst the Witnesses who have advocated an increase of State Assistance are some who have made great sacrifices in time and money in the cause of Scientific Research.

But whatever may be the disposition of individuals to conduct researches at their own cost, the Advancement of Modern Science requires Investigations and Observations extending over areas so large and periods so long that the means and lives of nations are alone commensurate with them.

Hence, the Progress of Scientific Research must in a great degree depend upon the aid of Governments. As a Nation we ought to take our share of the current Scientific Work of the World: Much of this work has always been voluntarily undertaken by individuals, and it is not desirable that Government should supersede such efforts; but it is bound to assume that large portion of the National Duty which individuals do not attempt to perform, or cannot satisfactorily accomplish.

The following considerations have been suggested to us by the Heads of Evidence relating to (1) Laboratories, (2) Observatories, (3) Meteorology, (4) Tidal Observations, and (5) the Payment of Scientific Workers.

1. The first condition of scientific investigation is that there should be Collections, Laboratories, and Observatories accessible to qualified persons. The evidence has shown that at present, for certain branches, these do not exist or are incomplete.

Moreover there can be no doubt that the Government Service should, to a great extent, contain within itself the means of carrying on Investigations specially connected with the Departments. Even having regard only to the current wants of the State, additional appliances are necessary.

Three distinct ways have been suggested in which the State might assist in providing the Aids to Investigation which are required by private Individuals. It has been proposed: first, that competent Investigators should receive Grants in Money enabling them to provide themselves with means for conducting their Researches; secondly, that Laboratories, designed primarily for the Service of the State, and those of Universities and other similar Institutions receiving Aid from the State, should be placed, under proper conditions, at the disposal of such Inquirers; thirdly, that Laboratories should be erected by the Government specially designed for the use of private Investigators, though, of course, also available for the service of the State. Wherever the first of these methods can be conveniently and economically adopted, we are disposed to consider that it is the simplest and the best; but it must be remembered that for many Researches apparatus of a costly, but durable character, are among the primary requisites; and that to provide these separately for each investigator would involve a large and unnecessary expenditure. It appears to us that the difficulty thus arising might be adequately met by the adoption of the second of the above suggestions. Our attention has, indeed, been called to the inconveniences which might arise from the admission of independent workers into University or State Laboratories. But, notwithstanding this difficulty, we think the experiment is one which ought to be tried, and till it has been tried we should hesitate to recommend the erection by the State, for the especial use of private Investigators, of Laboratories which would certainly be costly, and might possibly be only imperfectly utilized.

2. Upon a Review of the whole of the Evidence relating to the subject of Astronomical Physics, we are of opinion that an Observatory for that branch of Science should be established by the State. In the study of Solar Physics, continuity of the observations is of the greatest importance; and owing to our variable climate, continuous observations of the sun in this country are subject to peculiar difficulties which should be duly considered in the choice of the site for such an Observatory. The neighbourhood of London is less favourable to Physical Observations than many other sites which might be found, and for this reason we should prefer that a Physical Observatory should be placed elsewhere than at Greenwich. On other grounds, also, we think that the Observatory for Astronomical Physics should be an Institution entirely distinct from any of the National Observatories for Mathematical Astronomy. The subject of Mathematical Astronomy is vast enough to occupy adequately the whole energies of a Director, and it is especially important that Astronomical Physics should have the undivided attention of the Head of an Observatory, because its methods, which are of very recent invention, are as yet incompletely developed, and because, depending, as they do, on a continual comparison of celestial phenomena with the results of experiments in the laboratory, they are entirely different from those of Mathematical Astronomy.

Our opinion as to the desirability of such an Institution is confirmed by the example of Foreign Nations; Observatories for Astronomical Physics being already at work in various parts of Italy, and their immediate erection having been determined on at Berlin and at Paris.

We venture to express the hope that similar Institutions may before long be established in various parts of the British Empire. The regularity of the climatic conditions of India, and the possibility of there obtaining favourable stations at considerable heights, render it especially desirable that arrangements should be made for carrying on Physical Observations of the Sun in that country.

3. With respect to Meteorology we are of opinion that the operations of the Meteorological Office have been attended with great advantage to Science and to the Country. The subject of Meteorology is a very vast one, and any scheme for its proper cultivation or extension must comprise — (1) Arrangements for observing and registering Meteorological Facts; (2) Arrangements for the reduction, discussion, and publication of the Observations; (3) Researches undertaken for the purpose of discovering the Physical Causes of the Phenomena observed. The resources placed at the disposal of the Committee are inadequate to cover the whole of this wide field; and, having due regard to all the circumstances of the case, we believe that in selecting certain parts of it, as the objects of their special attention, they have been guided by a sound discretion.

We are also disposed to consider that although, as we have already said, the Meteorological Committee occupies an anomalous position, no other form of organization could advantageously have been adopted under the actual conditions. We think, however, that if, as we shall herein-after recommend, a Ministry of Science should be established, the Head of the Meteorological Office should be made responsible to the Minister. We fully concur with the opinion expressed by the Witnesses that many branches of Meteorology can only be effectually promoted by an organization having the support of Government; and we would draw especial attention to the consideration that, if Meteorology is to take rank as a branch of Terrestrial Physics, the observations must be made at stations widely dispersed over all parts of the earth's surface, and those taken by Observers of different Nations must be so arranged as to be comparable with one another. It is obvious that the intervention of Government would greatly facilitate the attainment of both these objects.

We are very unwilling that any Scientific Observations which can adequately be carried on by Individuals, or Associations of Individuals, should be undertaken by a Department of the Government. So far as the local interests connected with Climatic Meteorology suffice to ensure due attention being paid to that branch of science, we should prefer to see it left mainly to Scientific Societies, any assistance the Government might afford being merely subsidiary. That useful results may be obtained by voluntary effort is evident from the work carried on under the direction of Mr. Glaisher, and from the case of the Scottish Meteorological Society, which has succeeded, with very narrow means, in organising a valuable System of Observations on the Meteorology of Scotland. It is, however, important that any Grants for the promotion of Meteorological Observations in aid of voluntary efforts should be made on some systematic principle; and the attainment of this object would be furthered by making them subject to the Control of a Minister, who would be cognizant of all the facts relating to the expenditure of the Government upon Meteorology.

We may point out that the returns furnished by the Scottish Meteorological Society and Mr. Glaisher, are adopted by the Registrars General, and are recognized by Committees of Parliament in discussions affecting the Public Health, the Supply of Water, and other matters of the same kind. The value of Observations undertaken, as in this case, by private Individuals or voluntary Associations, must vary from time to time, according to the efficiency of the persons principally concerned in their superintendence. We feel, therefore, that the question how far it is proper that such Observations should receive official sanction, cannot be decided *à priori*, and must be left to the judgment of the responsible Minister for the time being.

4. With regard to Tidal Observations, it will be seen that, in the opinion of the Witnesses, these have not hitherto been conducted and reduced systematically. Considering the agencies which the Government can employ for the purpose of making these Observations, the importance of providing proper Superintendence for them, and of securing their Reduction, we think it desirable that they should be carried on under Government control. The expense involved would chiefly consist in the Establishment at proper points, and Verification, of Tide Gauges, and in the Reduction of the Observations; these being entrusted to officers of Government already stationed at the ports and on the various coasts of the Empire.

5. The Witnesses have expressed themselves strongly as to the Justice and Policy of Remuneration to Investigators for their Time and Trouble, and the Evidence also shows by implication how great must have been the sacrifices of those who without private fortune have hitherto devoted their great talents and their valuable time to such work without any remuneration whatever.

It has hitherto been a rule in the granting of Government Aid to Scientific Investigators, subject, so far as we have been able to ascertain, to but very few exceptions, that such Aid should be limited to what was necessary to meet the expenditure actually incurred on instruments, materials, and assistance.

To grants made under these conditions we think that considerable extension might be given.

It is hardly necessary to assert the principle that when Scientific Work is undertaken at the request of the Government, the State is not only justified in paying, but is under obligation to pay for what is done on its behalf and for its service. But we desire to express our belief that there are many instances of unremunerative Research in which the benefit conferred on the Nation by those who have voluntarily engaged in it establishes a claim upon the State for compensation for their time and labour. Without such compensation much important work must remain unperformed, because it must be expected that many of the best men will not be in circumstances enabling them to devote long periods of time to unremunerated labour.

It is a matter of course that State Aid shall only be given to Investigators whose capacity and industry have been placed beyond a reasonable doubt.

IV.—The Central Organization which is best calculated to enable the Government to determine its action in all Questions affecting Science.

The functions of the Government with regard to science may be summed up under the three following heads:—

First. The Treatment of the Scientific Questions incident to the Business of the Public Departments.

Second. The Direction of Scientific Instruction when given under the Superintendence or Control of the State.

Third. The Consideration of all questions involving State Aid towards the Advancement of Science, and of Administrative Questions arising out of such Aid.

It would be difficult to enumerate exhaustively all the various topics comprehended under these three Heads, and it will be sufficient for the purpose of showing how wide is the field of action of the State in regard to Science, if we point out that under one or other of these heads are included all Scientific questions affecting the Army, the Navy, the Public Health, the Mercantile Marine, Public Works, Government Scientific Establishments; the Elementary Instruction in Science under the Department of Education in Primary Schools, in the Science Classes connected with the Science and Art Department, and in Secondary Schools so far as they are subject to Government control; the Aid which is now given, or which it is desirable should be given, to Universities and other Bodies not directly connected with the State, for the Middle and Higher Scientific Instruction, and the Control which the State either does or should exercise over them in virtue of such Aid or otherwise; the Appointments to all Scientific Offices in the gift of the Crown; Grants to Museums and their Control by the State; Aid to Scientific Expeditions of every kind; the Establishment and Direction of State Laboratories and Observatories; Grants in Aid of such Laboratories not under State Direction, and in Aid of Scientific Research; and generally the allotment and control of Public Funds for similar Purposes.

The majority of the Witnesses who have given evidence in relation to this branch of the Inquiry, express dissatisfaction with the manner in which questions under the preceding heads are now determined, and either recommend the Appointment of a Special Minister of Science or of a Minister of Science and Education.

In most cases the Witnesses recommend that such a Minister should, in regard to Science, be advised by a Council. Others, however, are of opinion that the Functions of such a Council might be exercised by an Administrative Staff of the usual kind.

Before continuing our remarks on this subject we beg leave to lay before Your Majesty extracts from the Evidence which has been placed before us regarding the Appointment of a Minister of Science.

Extracts from the Evidence relating to the Appointment of a Minister of Science.

We have received a large amount of Evidence in favour of the Appointment of a Minister of Science. There has been almost complete unanimity among the Witnesses on this point. We give the following extracts:—

Professor Owen:

"I conceive that the recommendation by Bentham in the last century of such a minister can hardly fail to be practically adopted before the close of the present century, and that the necessity of having a minister for such a purpose will be recognised." Qu. 11,537

* * *

Sir W. Thomson:

"Would you contemplate that a new department of the State should be constituted for directing the scientific work of the Government?—It would be quite necessary to have a Minister of Science; it is indeed, I think, generally felt that a minister of science and scientific instruction is a necessity." Qu. 10,747

"Not a minister of other instruction?—Specially of scientific instruction, and not under any national education board, but a minister of science and scientific instruction. The minister would necessarily be in Parliament and a political man, but it would be very rare that he could also be a scientific man, and perhaps not desirable that he should be a scientific man, but he must have able scientific advisers always at hand." Qu. 10,748

"Could any such duties be well assigned to any existing department of the State?—I believe not." Qu. 10,749

"You spoke of the necessity for having a minister of science, do you conceive that it would be requisite to have a cabinet minister for education and a second cabinet minister for science, or would you contemplate that the minister for education should be the minister for science?—I do not wish absolutely to fix it beforehand; on the whole I think, however, that the title of minister of education would not suffice. If there is to be a minister, it must be a minister of science and education. There might be a minister of science and education, with a chief secretary or under minister for national and elementary education, and another for the advancement of science and for the higher scientific instruction. But naturally the minister of education must act for the masses; that must be his great duty, and however much he might wish to act for science, he has still a great duty to the masses. On the whole, I think that it would be preferable to have a distinct minister Qu. 10,759 of science and scientific instruction. A minister of science and scientific instruction, as a subordinate to a chief minister of science and education, might probably be a very good arrangement."

Qu. 10,764. "The minister of science administers knowledge to the whole country."

Col. Strange:

Qu. 10,980. "It seems to me that in the first place there should be some means of bringing science fully before the nation through Parliament. I know of no means of doing this that is in accordance with our constitutional procedure, except through a minister of state; and therefore assuming science to be a matter of enormous national importance, I think it is essential that it should be all brought under one minister of state, who should be responsible to Parliament for everything which is done in the name of the nation to further science, and who should frame his own estimates and keep them distinct from those of departments which have little or nothing to do with science. * * * * * I think that there should be an estimate for science just as there is an estimate for the army and for the navy." * * *

Qu. 10,982. "What I should be glad to see would be a minister for science, but I daresay that if proper assistance were given to such a minister, he might superintend other departments as well; for instance, as on the continent, he might superintend education and the fine arts. I think it would be preferable that he should be for science only. I think there is quite enough for him to do in England, for it to be done thoroughly; but rather than have no minister I would assign to him also education and the fine arts."

Qu. 10,983. "There would be a difficulty, would there not, in defining the boundaries between the duties of the minister for science and the minister for education?—I think not. I think one would relate to education, which is quite a distinct thing from national research, and I think that they should be kept as distinct as possible. I think one great evil now existing is the mixing up of those two things. Throughout my evidence I have here and there expressed the same opinion that they should be kept distinct, one being the means, the other the end; instruction I conceive to be the mode of growing a certain number of persons fit to investigate."

Mr. De La Rue:

Qu. 13,036 "I think that science ought to be recognized in the ministry by the appointment of a science minister, in order that all matters relating to science might come properly under the cognizance of the Government, and that whenever the Government sought the aid of scientific men it should be through the intervention of the science minister." * * * *

Mr. John Ball:

Qu. 7222. * * * "If science is to be aided effectually, and at the same time controlled effectually, there should be some permanent officer in the department of the Government that has its relation with science, whose duty it should be and who should be responsible for making himself generally aware of the state of science and the doings of its cultivators, and who should be the proper person to advise the Government, not as to the best mode of deciding a strictly scientific question, but as to where the means for solving it are to be had. I look upon it at present as being a wholly haphazard matter how questions of science or connected with science and affecting the progress of science are decided in the public offices, and I speak from some slight personal acquaintance with the matter during the short time that I was in the public service in Parliament."

Qu. 7233. "You stated, did you not, that you thought it desirable that there should be some permanent official to represent and advise the Government in its relations to science?—Decidedly."

Mr. Gore:

Qu. 10,813. "I think there should be a scientific department of the State, which should have the control of the money expended by the State upon scientific matters."

General Strachey:

Qu. 11,875. "The first conclusion that I arrive at is, that all questions relating to scientific matters that arise in the operations of the Government should be dealt with by one of the chief ministers of the Crown, and the officer at the head of the Education Department seems to be the most suitable of such officers. It has been, I know, suggested by some persons that it would be better if there were a separate department for science. That I venture to doubt." * * *

Qu. 11,876. "Under such an education and science department there would be a natural division of the duties, which would probably lead to the appointment of some permanent officer in the position of an under secretary of state, who would have specific charge of the scientific duties of the department as distinguished from the educational duties, which constitute a distinct branch of administrative work." * * * *

Qu. 11,878. "The principal officers in the proposed scientific branch of the department should be, by their scientific qualifications, capable of disposing of the ordinary current business under their charge." * * * *

Dr. Sclater:

Qu. 12,043. "Do you agree with [Col. Strange's] views as to the creation of a Minister of Science and a Council of Science?—Yes, I agree generally with his views; I think that it would be very desirable for the interest of science."

Qu. 12,044. "Do you think it would be desirable that the existing State scientific institutions should be removed from the control of the Admiralty, the Office of Works, and other departments under which they are now placed?—I think it would be a very great advantage that they should be removed from those departments and placed under one minister."

Qu. 12,045. "Have you any opinion as to whether the work could be done by a minister of education, supposing such a minister were appointed?—I think it would hardly be expected that a minister should be appointed only for science; and as I believe it is the case in continental countries that that department is given to the minister of education, I think that we could not follow a better example here."

Professor Balfour Stewart:

Qu. 11,505. "I think it [the ministry of science] might form a division, perhaps, of the ministry of education."

Mr. Farrer:

Qu. 12,673. "I dislike very much the idea of establishing new departments of the Government. If it were possible that this business could be placed upon the Minister of Education, who is becoming more and more important, I think that would be much better than establishing a separate department for the purpose."

Sir George Airy does not appear to be convinced of the advantages likely to be derived from the creation of a Science Minister, so far as it would affect the Scientific Departments.

"Do you see any inconvenience arising from the several scientific institutions that are more or less connected with the Government being under different departments?—Not that I am aware of." Qu. 10,523.

"You are content that the Royal Observatory at Greenwich should remain under the Board of Admiralty. You do not require to have a Minister of Science, or a Minister of Education?—No; we are naturally connected in these respects with the Admiralty." Qu. 10,524.

* * * * * * *

The proposal to establish a Council of Science.

A proposal to establish a Council of Science was brought before the Government by the Royal Society in 1857, upon a Report from the Government Grant Committee of that Society.

The object of the Committee was (Evidence of Sir E. Sabine, qu. 11,117), to determine "whether any measure could be adopted by the Government which would improve the Position of Science or its Cultivators in this Country."

The report, as quoted by Sir E. Sabine (Qu. 11,119), was as follows:

"With regard to the question of which the consideration was referred to the Government Grant Committee on the 11th of July 1855, namely, whether any measures could be adopted by the Government or Parliament that would improve the position of science or its cultivators in this country, the Committee beg leave to recommend the following resolutions:— Qu. 11,119.

"1. The Committee regard with much satisfaction the steps already taken in the Universities for advancing the study of physical science by including several branches of it in the public examinations, and express their hope that the improvements thus introduced may receive the extension which the interests of science require, and that the public schools may be thereby induced to make physical science an integral part of their course of education.

"2. The Committee recommend that the establishment of classes in metropolitan and provincial schools, where those who have not the means or opportunity of studying at the Universities may be taught the elements of physical science on a systematic plan, be promoted by grants from Government in aid of such funds as may be locally contributed for that purpose.

"3. That the formation of provincial museums and libraries be encouraged in like manner, and that provincial lectures, accompanied by examinations, be established in Great Britain in towns which request this assistance, and engage to provide a part of the expense, such lectures to be in aid of the schools above-mentioned, so that by means of the two combined a sound knowledge of the principles and application of science may be systematically taught.

"4. That duplicate specimens from the British Museum and other institutions, supported at the public expense, be distributed to provincial museums.

"5. That national publications bearing on science be more extensively circulated than they are at present by additional donations to societies and individuals engaged in the cultivation of science.

"6. That the sum placed annually by Parliament at the disposal of Government for the reward of Civil Services, 'useful discoveries in science and attainments in literature and the arts,' be augmented; that the portion to be appropriated to science be defined, and that it be sufficiently large to admit of the grant of annuities of the nature of good service pensions as rewards of eminent scientific merit.

"7. That the sum placed at the disposal of the Royal Society for the advancement of science be not necessarily limited to the annual grant of 1,000*l.*, when on any occasion special reasons may be assigned for an additional sum.

"8. That scientific officers be placed more nearly on a level in respect to salary with such other civil appointments as are objects of ambition to educated men.

"9. The Committee regard with much satisfaction the steps already taken for the concentration of the principal scientific societies in Burlington House, and trust that the period is not far distant in which permanent accommodation will be afforded to the principal scientific societies in buildings to be erected near the same site, and in pursuance of the same general plan.

"10. While it may not be expedient to interfere in any way with the functions confided to the President and Council of the Royal Society in reference to the distribution of the Parliamentary grant, or with the ancient and recognized relations between the Royal Society and the Government, at the same time it appears to the Committee that much benefit would arise from the formal recognition of some board which might advise the Government on all matters connected with science, and especially on the prosecution, reduction, and publication of scientific researches and the amount of Parliamentary or other grants in aid thereof; also on the general principles to be adopted in reference to public scientific appointments; and on the measures necessary for the more general diffusion of a knowledge of physical science among the nation at large; and which might be consulted by the Government on the grants of pensions to the cultivators of science.

"11. Assuming that the above proposal should meet with the approval of Her Majesty's Government, it will be desirable to ascertain what mode of constituting such a board would inspire them with most confidence in its recommendations. Two modes may be suggested in which such a board might be organised. First, the Government might formally recognise the President and Council of the Royal Society as its official adviser, imposing the whole responsibility on that body, and leaving it to them to seek advice when necessary in such quarters as it may best be found, according to the method now pursued in the disposal of the Parliamentary grant of 1000*l.* The second method would be to create an entirely new board, somewhat after the model of the old Board of Longitude, but with improvements. The question as to which alternative shall be adopted is properly a subject for the consideration of the Government.

"12. Such of the above recommendations as involve the expenditure of money, might be eventually carried out by appropriating to this purpose a certain portion of the fees received from the grantees of patents, after providing for all expenses which ought to be defrayed from that source. The Committee are satisfied that no application of these fees could be devised more appropriate than the devotion of a portion of them to the encouragement of abstract science, to which practical art is under so many and such important obligations."

The proposal to establish a Council of Science has recently been revived by Colone Strange.

Amongst the Witnesses who recommend the Appointment of a Council, there is a great diversity of opinion as to its Constitution and Limits of Action. As regards its Constitution, it will be seen from the Summary of Evidence which we shall give subsequently, that while some of the Witnesses are in favour of a Council very limited in numbers, others would desire to have it sufficiently numerous to include Representatives of nearly every branch of Science, as well as Men of known Administrative Ability.

In regard to its Limits of Action, the main difference arises on the two questions, whether the Council should or should not have the power of Initiating Inquiries, either directly or by suggestion to the Minister, and whether or not it should itself undertake the actual work of Investigation required for State Purposes.

As to the Mode of Remuneration, the opinions vary between those which advocate annual payments to permanent officials, and those which are in favour of payments for attendance at meetings.

The Opinions of the Witnesses who are opposed to any such Council are based, in the main, upon one or more of the following objections:—

1. That Government can get the best advice without it.
2. That it would be liable to come into collision with Ministers.
3. That it would not work harmoniously with our General System of Administration.

The Evidence of three eminent Statesmen possessing great administrative experience——Lord Derby, Lord Salisbury, and Sir Stafford Northcote,—is in strong contrast (so far as the proposal to establish a Council of Science is concerned) with that which we have received from many persons holding official positions in various Branches of the Public Service. The Opinions of these latter, as to the Inefficiency of the Organization of their Respective Services in regard to questions affecting Science, we have already quoted in the First Part of this Report, and it will be seen, from the quotations we are now about to give, that they in general consider the creation of a Council to be the proper Remedy.

Extracts from the Evidence in favour of the Establishment of a Council of Science.

We fear that no mere extracts from the Evidence of Colonel Strange would represent in an adequate manner the views which have led him to recommend the formation of a large and highly-paid Council of Science. It would scarcely be fair to him, as the most prominent advocate of the proposed measure, to do otherwise than refer to his Evidence at length, pp. 75 to 92, and 125 to 135, Vol. II. of Evidence.

Sir W. Thomson's Evidence with reference to the Establishment of a Council of Science is as follows:

Qu. 10,677. "Do you think that a single body would be better than a number of small committees for advising the Government on the great variety of questions which from time to time would be likely to arise?—Yes, certainly."

Qu. 10,678. "The questions which might be referred to such a Council would differ very much from one another, and extend over a wide range, would they not?—Yes, but there would be an unity of design and action, with a multiplicity of knowledge and skill at command, secured by a single council, and those conditions cannot, in my opinion, be secured at all by occasional committees, or committees working separately and independently of each other." * * * * *

Qu. 10,679. "A scientific council would relieve the Government of all responsibility in such matters, and would be responsible itself in a general way for all its proceedings to a political chief and to Parliament." * * *

Qu. 2694. "Have you formed any opinion as to the constitution of such a committee as we have been referring to: how the members of it should be selected?—I have no other opinion than that the men whose advice may be considered as most valuable and useful to the Government ought to be asked, quite independently of their connexion with any institution, whether under the Government or in the universities, or in connexion with any public or private body in the country."

Qu. 2695. "You would contemplate that committee being formed by the Government itself, and not that the universities or the scientific societies should have the right of nomination?—Certainly by the Government; but aided by recommendations from the universities and scientific societies, and from this proposed consulting committee after its first constitution."

Qu. 2868. "Would you have them a permanent body, with, it may be, a certain number of members going out by rotation, or in the event, suppose, of a change of Government, would you throw over the whole body?—A non-political body, I think, would be necessary for good action."

Qu. 10,691. "Would you leave the selection of each appointment to the Government of the day, or would you allow scientific societies or other bodies to recommend, or would you propose that the Government should be obliged to consult such bodies?—I would prefer that the Minister of Science should have the appointment."

Dr. Frankland thus deals with Colonel Strange's Proposal:

Qu. 11,082. "Are you acquainted with Colonel Strange's proposal for the establishment of a consultative council of science?—Yes, I have heard from him some of the chief ideas that he entertains on that subject."

Qu. 11,083. "Are you disposed to consider that such a council would be desirable?—I think so. I am not prepared to say that it should be constituted exactly in the way that Colonel Strange mentioned, but a council of that description would be exceedingly desirable, on many grounds, for furnishing the Government with trustworthy scientific opinions in cases requiring them." * * *

Qu. 11,086. "Are you of opinion that the advice of such a council, even on matters to which the larger proportion of the members of the council had not paid special attention, would be valuable?—Yes, I think it would, because those members of the council who were thoroughly acquainted with the subjects would be expressing their opinion to men conversant with scientific methods, and they would be able to convince their colleagues with respect to the opinion that the council generally ought to give upon the matter. It would be a very different thing from that of convincing a parliamentary committee, for instance, upon a scientific point, because all the men upon the council would have received a scientific training, and would understand the bearing of scientific arguments."

Qu. 11,087. "Have you considered at all how such a council could best be appointed, whether would you leave it to one of the ministers to appoint and select the proper persons to serve on the council?—I should think that it must ultimately fall upon the minister, but he might be assisted by the presidents of different learned societies or by the council of the Royal Society, in whom I think everyone would have confidence."

Mr. Farrer suggests the formation of a Council which might be closely connected with the Royal Society.

Qu. 12,634. "Have you any suggestions to offer as to the best modes, as it appears to you, of solving problems which from time to time present themselves?—I think if upon purely scientific questions there were some scientific body of some kind to whom the Government departments could as a matter of course refer for the solution of such questions as this, it would be a great advantage."

Qu. 12,636. "I have looked at the suggestions that have been made by Colonel Strange and others, and I do not think that any Government department or its professional officers would listen to the dictation of any council of purely scientific men; they would probably say, and say with justice, that they knew more about what was wanted than any such council could know. Every now and then in the course of practice in those cases a new scientific question does arise; such, for instance, as the question concerning deviation of the compasses. In such a case as that we required the best scientific assistance we could get; and in the case of sulphur in gas, and water impurities, we now require it."

Qu. 12,643. "I give with great hesitation a suggestion upon a point upon which I really am scarcely competent to suggest anything, namely, whether you had not better make use of what you have at present, namely, the Royal Society or a committee of the Royal Society, rather than attempt to establish any new body. No new body that you could establish would have the prestige, reputation, and influence that the Royal Society has. That is a matter not to be created; it is a matter which has grown with centuries. You have also in the Royal Society itself a scientific public to whose opinion any council or committee appointed by it would or might be made amenable; and my suggestion would be that you should endeavour to create some committee or body out of the Royal Society which should bear a fixed relation to the Government, which should meet regularly, and the members of which should be paid something, as the directors of a joint stock company are paid for their meetings, to whom the Government should have a right to refer, who should feel that they had on the one hand a duty towards the Government, and who on the other hand should be bound to make public all their proceedings, so that they would be responsible to the public scientific opinion of the country. That is the best suggestion that I can make, but, as I say, I am very ignorant upon the subject."

Qu. 11,585. Admiral Richards is of opinion that the appointment of a Minister of Science and of a Council stand and fall together; and thinks "that the one would not be of very much value without the other."

But, as regards the Admiralty, the Department which he knows best, he would prefer that it should be able to decide Scientific Questions within itself. He says:-

Qu. 11,591. "I think that the Admiralty requires the aid of such a council less, perhaps, than any other department of the Government, for this reason, that there are not very many questions, purely questions of science, that come under the notice of the Admiralty; and then we have the Astronomer Royal to refer to, who is a host in himself, and if any question arises which we do not refer to the Astronomer Royal, we generally ask the President and Council of the Royal Society, and we have never found any difficulty in getting assistance. The only department of the Admiralty which might require such assistance beyond this, is perhaps the Constructors' Department, in the designs for ships of war. But as regards that, my opinion is that it would be far better to have some scientific designer attached to that department than it would be to refer such questions to a council even."

Qu. 11,592. As to the Admiralty deriving any advantage from the appointment of the proposed Council, he adds:

"There would be this advantage, I think, which they would derive, that they would be freed from the political pressure which is brought frequently to bear upon the Admiralty upon questions of that kind. The whole responsibility of deciding upon a measure would be thrown upon the council."

Qu. 11,593. "Do you think that would be a desirable result?" "I think that it would be desirable in all departments of the Government; it would be very agreeable to the Government of any day, I should think, to escape the responsibility of deciding on scientific questions on which they may not be very intimate, but in which they may be believed to be interested parties."

Qu. 11,594. "Do you think that the work would be better done?" "I think it would. I should say there could be no doubt about that, but unless the Government are prepared to vote a very considerable sum every year for the advancement of science, which I am quite of opinion that every Government ought to do, I think very little benefit would accrue from having such a council."

Qu. 11,427. Dr. Balfour Stewart is also in favour of a Council :

"You have no apprehension that the Government, if advised by men of the highest scientific capacities, would be likely to operate so as to control science, and to fetter the operations of individuals, or to benumb and discourage Original Research and Observation ?"

"I think not. I think that the great desideratum is to put more means at the disposal of private individuals, and, of course, this must be done by some sort of administrative body."

Qu. 11,515. "In what way would the advice of the council be better than that of the individual members of that council, who are the highest authorities on the question under review ?—Because I think that science has a number of bearings, and that a question might involve, not one branch of science, but a great many, and you might, for instance, have to call in various men of science of different kinds. In order to answer this question, you might have to call in, not the advice of one member of the council, but the advice of a number. Of course there are a number of questions regarding which some of the members of the council would naturally be silent, but perhaps a good many of them might be interested in answering a particular question, and would give their answer. In a case of that kind I should fancy, however, that it ought to come as from the whole body, because, really, in most questions now-a-days, the question would not involve one particular branch of science only, but it would involve the joint operation of two or three branches of science."

Qu. 11,516. "Take, for instance, such a question as that which has been recently referred to a committee, the efficiency and stability of ships of war, would there be any advantage in referring a question of that kind to the council, rather than to a committee specially appointed, as has been done on the occasion to which I refer ?—I think that if there were a council of this kind, the council would have power to associate other people with them in a case of that kind. Science is so ramified, that the council would not be able of themselves to settle all questions ; but upon particular questions, such as you name, very likely they would associate other people with them."

Qu. 11,517. "Do you think that they would be more likely to make a judicious selection of the persons to be consulted than the Minister of State would be, without the advice of such a council ?—I think so, because a Minister of State is not likely to know the capabilities of various men. There are a number of men known to scientific bodies as profoundly conversant with particular branches of science, but their knowledge of those subjects does not appeal to outsiders, it only appeals to those who are cognizant with that particular subject." * * * *

Dr. Roscoe is in favour of a Council, and would give a voice in its appointment to the Learned Societies :

Qu. 7436. "Can you make any suggestions as to the mode in which Government aid could be best carried into effect ?—I do this with the greatest diffidence ; but it appears to me that the system of a consultative council, to advise the executive on matters of scientific instruction, is the true one. I believe it is a work which it is almost impossible that the executive can do properly without advice received in some form, and that appears to me the form in which it is most likely to be productive of the greatest good."

Qu. 7437. "Have you any suggestions to make as to the constitution of such a council ?—I should be inclined to think that a council, formed on the same plan as this Commission, so far as regards the class of its members, would be a very proper one to advise the Government."

Qu. 7438. "Would you think it advisable that the Government should name its own consultative council, or that some of the members should be nominated by the societies ?—I should provide for a certain number of scientific men being upon the council, and desire that the Government should nominate (for you may trust the Government to do it with fairness), as well as the societies ; that is, the lay members should be appointed by Government, and the professional ones by the various scientific societies." * * * *

Dr. Sclater agrees generally with Colonel Strange's views, and thinks that a Council
Qu. 12,043. "would be very desirable for the Interests of Science."

He then proceeds to state his opinion as to its Constitution :

Qu. 12,046. "Have you formed any opinion as to the constitution of a consultative council to assist this minister ?—My idea would be that the heads of the different scientific institutions that are put under the control of the department of science and the minister of education might form a consultative body and be called a council of science, and that there might be certain other members added to assist them in deliberation, if it were thought necessary, such as representatives of the College of Physicians, the College of Surgeons, and of the scientific branches of the Army and Navy."

Qu. 12,047. "Colonel Strange's proposed council would consist of 30 members at least ; do you think that that would be too numerous a body ?—I think that a less numerous body might suffice, because I see that, in many cases, however numerous the body was, it would be necessary to call in special assistance."

Qu. 12,049. "If a council were constituted in the manner that you propose, should you contemplate that, as a rule, they would be capable of giving advice themselves on most questions that would arise, or would they generally find it desirable to call in further assistance ?—I think, that in most cases, they would be quite competent to give an opinion to the Government ; but that sometimes on particular questions, it would be necessary to go elsewhere for advice, and that, in such cases, there would certainly be somebody in the council who would know exactly where to put his hand upon the right man for the purpose. For instance, a question might arise in some special department of Natural History : in that case, the council would naturally refer to the head of the State Museum of Natural History to know if he could give an opinion himself, and if not to inform them who could give an opinion upon the point. Thus, I think that with the aid of a small council of science of, perhaps, 20 members, every question requiring solution by the Government as regards science might meet with very fair consideration and be very easily settled."

Qu. 12,054. "Have you any misgivings as to whether such a council would command sufficient public confidence amongst men of science ?—I have no misgivings at all upon that subject. I should say that they would meet with general support from men of science. Most men of science, I think, see that something of the sort is imperatively required. All lament the piecemeal way in which scientific subjects are dealt with by Government, in consequence of their being subdivided amongst all these different offices, and of there being nobody to appeal to upon a question of science, and, therefore, I think the proposal to establish such a council would meet with universal acceptation amongst scientific men."

Qu. 12,07 "Then, in the case of investigations which were required to be undertaken, how do you conceive that they would be dealt with?—I should say that the member of the council representing the particular branch of science would be called upon to present a preliminary report of how he proposed to set about any particular investigation. He would say, to do this I shall require the assistance of such and such persons for so many days, or for such and such time, or to send here or to send there, and would bring these requirements in the shape of a preliminary report before the board, and, if this were approved, would carry out the investigation. Then he would present his report upon the result of the investigation, and the council as a body would consider it, and recommend its adoption by the Government or otherwise."

Qu. 12,07 "Then do I understand that you would prefer, as a general rule at least, that the members of the council should themselves carry out such investigations as might be required from time to time, rather than that they should merely indicate to the minister the person, outside the council very probably, who they thought was best competent to carry out the investigation?—I do not think it would be necessary to draw a hard and fast line upon such a question as that. I think that in many cases it would be better that the council, as a whole, should report to the Government on the best way in which any particular scheme might be carried out. I do not think that it would be necessary to introduce a rule that you should invariably go to the member of the council representing that particular science if advice were wanted upon that branch. But the council would naturally turn to the representative of the particular science for an answer; they would naturally look to his advice first."

Qu. 12,07 "I understand you to mean that the duty of the members of the council should be to know where to go in order that particular questions should be answered, whether it were to go outside the council or to go to one member of the body?—Yes, that is my opinion."

His remarks on the question whether there should be on the Council men having Administrative Experience are as follows:

Qu. 12,0 "I think that the heads of great scientific institutions must have administrative experience. If a man has to manage an institution like the Royal Observatory at Greenwich, or the State Museum of Natural History, he must have the command of a great many men under him, and must be acquainted with the business of the institution, and must have gained his administrative experience. He could not fail to be a person of administrative experience."

Qu. 12,0 "But, taking the application of scientific laws to specific departments of the Government, the army and navy, for example, would it not be important that there should likewise be on the council some men of special knowledge of the mode of facilitating the adaptation of scientific laws to those departments?—I think, certainly, that the army and the navy, which are the branches of the service, perhaps, most requiring scientific assistance, should be represented by one or more members at the board, and no doubt the Government would take care to secure a first-rate man for what I should consider a post of the very highest honour."

Qu. 12,0 As to the numbers composing the Council, he considers "that it would not be advisable to have a larger Council than was absolutely necessary," for the reason that a small body of men generally work better and do more work than a large body; at the same time he does not think that 20 would be a very large number.

Qu. 12,1 Dr. Hooker, the President of the Royal Society, gives it as his opinion "That the general proposition, that the Government should be aided by scientific persons, is an excellent one, both with respect to the administration of the existing Government Scientific Institutions, and with respect to the occasional grants which the Government may be called upon to make for scientific objects." Like Dr. Roscoe, he thinks that the Council should not consist exclusively of Scientific men.

Mr. De La Rue thus gives his opinion:

Qu. 13,0 "There ought to be a board of advisers which should consist of men eminent in different departments of science. I can only speak as to those branches of science to which I have paid some attention, and I should put in the first category that there ought to be on the board a chemist of eminence, there ought also to be a physicist, an astronomer, a mathematician, particularly one who has paid attention to the application of mathematics to science, and an engineer or two engineers, one who has given attention to the construction of great works, such as railroads and bridges, that is to say, civil engineering, the other a mechanical engineer. I do not speak of a biologist or a physiologist, because other witnesses are much more competent to speak as to the necessity for such men than I am."

Qu. 13,0 "But do you think that all branches of science ought to be represented on the council?—Undoubtedly."

Qu. 13,0 "Can you give the Commission any idea as to the number which you think it would probably be necessary to provide for?—About 10 or 12 men, I imagine, would sufficiently represent science."

Qu. 13,0 13,041. Qu. 13,0 He would give some voice in the selection of the Members to certain Societies, and would not require the Members to "relinquish any other position that they might already hold."

Qu. 13,0 Qu. 13,1 Qu. 13,1 As to the numbers of the Council, he says that "If 12 men were not found to be sufficient to include all branches of knowledge, it would be desirable to increase the number." He proposes "that special advisers might occasionally be called in who would be remunerated according to their attendance." * * * *

He considers that the usual permanent staff of a Secretary and Assistant Secretaries, even if they were men of Science, would not be sufficient; urging as a reason that

u. 13,125. "Science is really now so extensive that one could hardly imagine any secretary so to be intimately acquainted with every branch of science as to be able, even with the aid of his assistant secretaries, to advise, or to point out where to obtain specific information on every question which might be brought under consideration. I think, therefore, that there would be a very great advantage for the Science Minister to have a sufficiently numerous Advising Council."

He considers that promptness of action would be promoted by the appointment of a Council:

u. 13,126. "There ought to be a body of men who could be immediately called together, whose time was so far at the disposal of the State that they might be assembled on every occasion and at any time to advise the Science Minister. Then we should get prompt action, instead of questions being allowed to drag over years and years without any practical solution being come to."

u. 13,131. But even if a Council were appointed, he thinks that such branches of the Government as the Admiralty, the War Office, and the Public Health Office "should be specially "scientific, each in its own department."

u. 13,134. In answer to the question, "Have you no fear that there might be some collision, or, "at any rate, considerable friction, between that Council and the Scientific Departments "of the Public Service?" he says:

"Probably at first there might be, but ultimately I believe the confidence of those directors of the departments would be gained by the very sound advice which they would receive from a body constituted as I conceive it ought to be."

He does not think the Government Grant Committee could be so modified as to render a Council unnecessary.

u. 13,135. "Supposing 5,000*l.* or 10,000*l.* were given to the Royal Society to aid investigations, I do not think that that in any way ought to weigh in the consideration of the establishment of a science minister whose functions would be altogether larger and much more important. We want science really cared for in England by the State, and we want all State questions relating to science properly considered by a body capable of dealing with them."

Professor F. Jenkin is in favour of an Elective Board:

u. 1658. "I think that the judging of the applications for assistance, applications for the endowment of new chairs, and the application of Government patronage generally as regards science might be managed by the following system. Supposing that instead of the grant being given simply by the Department itself (speaking now of the Committee of the Privy Council) there were a representative board composed of men of science, composed of professors who could advise—I will not say that they should have the power of deciding—I would rather leave that with the Government, but that they should have the power of reporting at any rate upon each of those applications, I think that the Government would get better advice than it can command at present. My idea is that this board should be an elected board, that each of the existing colleges (you could easily choose the colleges and universities) should appoint one member at such a board as that; but however the choice was made, if there were something like a representative board of scientific men to advise the department, even if their recommendations were not necessarily acted upon, but that they were simply a reporting body, I think that the Government would be better able to decide on such subjects than they can now do, and that their decisions would give greater satisfaction."

* * * * *

u. 1659. "I do not know how otherwise the Government is to decide who is really the best man. We cannot have competitive examinations for professorships, I think, and the system of irresponsible testimonials has come to be in a monstrous state. A man really prepares a blue book; every man one has ever spoken to sends for a testimonial, and you get a whole library of those testimonials." * * *

Professor Martin Duncan points out an important way in which the Council could be utilized:

u. 7704. "With reference to any endowment that might be granted by the Government, have you formed any idea as to the control under which the administration of such endowment should be placed?—That is a matter which I have thought over, and I see that it might lead to great difficulties. The Government might wish to nominate a Professor of King's College, and such a professor might be objectionable to the Council of King's College, and I think it would be more satisfactory to scientific men if all those appointments were placed under the care of a board of scientific men of position, and who would be responsible to the Government for their nominations, and for the duties of the professors being well carried out. There would be no difficulty in obtaining such a board, because the presidents and officers of the learned societies, which have charters, would make a sufficiently good board, and a board beyond doubt as regards their scientific acquirements and their desire to uphold science. To leave the matter entirely in the hands of the Government would, perhaps, not lead to very satisfactory results."

u. 11,973. Mr. Spottiswoode considers Colonel Strange's suggestion the most complete and perfect that has yet been made, and states that he has "always looked upon it as an arrangement to the carrying out of which all others should be directed;" at the same time, however, he considers "the proposal is a large one," and suggests that "it might be worth consideration whether some intermediate scheme for earlier action should be proposed."

His opinion on the Appointment of the Members is thus expressed:

> Qu. 11,97 "If any council (without at present going into its constitution) were appointed, in whose hands do you think that appointment should be placed?—I think it clearly should be in the hands of the Minister with whom it would be in direct relation."
>
> Qu. 11,97 "You would leave the choice absolutely to him, and not make the appointments in any respect *ex-officio*?—There might very well be certain *ex-officio* members, such, for instance, as the Astronomer Royal for the time being, the President of the Royal Society for the time being, and perhaps others."
>
> Qu. 12,01 "The greatest importance would attach to the first constitution of the council?—Certainly."
>
> Qu. 12,01 "How would you advise the minister to proceed in order to act wisely in that appointment?—I should suppose that he would obtain advice from the leading men of science of the day, and with their advice it would not be difficult to form, at all events, the elements of such a council, although he might not be able at once to complete a very fully organized body. If those first appointments were made, he would have the full advantage of the advice of those members in completing the entire list."
>
> Qu. 12,03 "If such a consultative council were appointed, you would probably contemplate that it would be mainly composed of persons now to be found on the council of the Royal Society, or on the committee of recommendations of the British Association?—Yes, I should imagine that it would be mainly composed of Fellows of the Royal Society."
>
> Qu. 12,03 "How would it work if there were some arrangement by which the council of the Royal Society should propose a certain number, two or three persons out of whom the Government might select one on any vacancy?—I see no objection whatever to that proposal."
>
> Qu. 12,04 "That would secure, as a general rule, the appointment of persons of the highest scientific qualifications on the council?—I think it would."

Qu. 12,56 Sir Henry Rawlinson thinks that the Council should be merely consultative. He regards the nomination of a Permanent Council of Science as the natural remedy for the "spasmodic" action on the part of the Government, and adds:

> Qu. 12,55 "It appears to me that the chief and most important point in this matter has reference to the appointment of a Council, rather than to the nomination of a Minister. I think with a Consultative Council of Science there would be a corresponding uniformity of action." * * * * * *
>
> Qu. 12,56 "In the Council of India we have no power of initiation. The initiative rests with the Minister, or, practically, with the executive officers, acting, I may say, on the inspiration of the Minister, and the measures are only brought before the Council, in a subsequent stage, for their approval or disapproval."

We have already quoted the Evidence of this Witness as to the difficulties which the Government Departments, and more especially the Indian Council, meet with for want of authoritative Scientific Advice. In answer to question 12,564, he goes on to say:

> Qu. 12,56 "I may mention to the Commission, in reference to this subject, that the desirability of such a council is constantly brought to my observation through another channel, namely, through my duties in the Council of India, where we perpetually have references before us, which we are really unable to deal with. These references recall most forcibly to us, and very frequently, the necessity for the existence of such a council as I have proposed." * * * *
>
> Qu. 12,5 "Should you apprehend that a minister would find it a very difficult task to constitute a council in such a manner as to command the confidence both of the public and of scientific persons?—No, I should think not. I should think a minister, with the latitude of selection which he would have in a country like this, would have no difficulty in bringing together a council of 10 or 15 gentlemen whose qualifications and reputation would command the respect of the world, and whose opinion would fortify him in his decisions, and be of great national benefit."

General Strachey has given us some important Evidence as to the Appointment and Functions of a Council of Science:

> Qu. 11,87 "The persons who are employed in the public administration are certainly as a class not amongst those who have anything deserving the name of scientific education; therefore, for a long time to come, it is not to be expected that the members of the Government, or their chief subordinates, will have any such general knowledge of science as would enable them at all satisfactorily to deal with the scientific questions which come before them. Therefore, I conclude that it is absolutely essential for the Government, under any circumstances, to get advice from outside; and then comes the question as to how this advice is to be got. If there is no recognised and regularly organised body whose business it is to give advice to the Government on such subjects, then the only thing that a minister can do is to get his information from unrecognised and irresponsible authorities, persons whose opinions, perhaps, may be very valuable, but still persons of whom the public never can have any cognizance; and private advice given in that way seems to me given in the worst possible form. If, then, that form of advice is bad, how can you obtain advice of proper intrinsic value on the multifarious subjects on which it is certain to be needed by an administration really striving to advance science to the utmost, and how can you secure its being given under a sufficient sense of responsibility, and in such a way as to carry the greatest weight possible to the mind of the minister who is expected to act upon it? And here I would repeat that any specific proposal to give effect to such an idea must be made to fit into the general form of the administration; and I, therefore, consider that the best course would be to adopt the proposal that has been made by many persons, that there shall be some sort of council constituted to advise the responsible Government department as to its proceedings in connection with science."

This Witness objects to the proposal that the Council should be elected by, or selected mainly from Scientific Bodies, or Educational Establishments, and considers that—

u. 11,879. "The only way to lead a Government in the proper course which they should pursue in relation to science is, to give them advisers whom they have agreed to accept, and whom they are, therefore, forced to admit as trustworthy and satisfactory guides. The only way in which that sort of relation between them can be established, I think, is to put a specific responsibility upon the Government to nominate. I think, too, that there would be, under such an arrangement, an action of a similar character in the other direction, and that a person who was specifically nominated by the Government to perform those particular duties would have a much stricter responsibility put upon him, so to act and so to advise the Government as to produce satisfactory results, than if he were merely developed, so to speak, by the operation of some external body."

u. 11,882. "I think that in order to put propositions in a practical form and in an acceptable form before the minister, it is desirable that there should be persons in the advising body who have a certain amount of administrative experience. Also, I think that, as society is constituted now, there should be in it persons of what is commonly called superior social position, such persons having certain advantages in getting access to the minister, and in guiding public opinion, which others have not. What should be aimed at, in short, is a practically useful body rather than an eminently theoretical scientific body; and I should say that a body not differing materially from this present Commission has the sort of constitution which would secure the best exercise of the influence which I conceive that this advising body should exercise. I think that all that would be necessary to enable it to do all that could possibly be required of it, would be to entrust it with suitable power, where the occasion required, for making specific references, or for calling into its councils persons specially qualified to advise it, who were not permanently upon the Commission. I think that an arrangement of that sort could be carried out without any particular difficulty."

u. 11,883.
u. 11,884. He thinks that the body should not be very numerous, suggesting nine as a sufficient number, on the ground that the larger the body the more divided is the sense of responsibility, and also on the ground that under certain circumstances the larger the body the less is the weight that is attached to its opinion.

He would give considerable Initiative Powers to the Council:

u. 11,885. "Would you propose that this council should initiate proposals itself, as well as consider subjects on which its advice was asked?—Yes, I think so. I think that the greatest freedom of action should be given to the Council; that it should be in a position to make any representation that it thought desirable to the minister on the subject of science." * * * *

He disapproves of the suggestion that the Council of the Royal Society should perform the Functions of a Council of Science:

u. 11,886. "Would such a body as you are proposing supersede the Government Grant Committee?—Yes, certainly; and I would take the opportunity of saying that it is a question that is open, and which I believe has been discussed, whether the Council, for instance, of the Royal Society, with or without any addition, might not be made to perform satisfactorily some or all of the functions which it has been suggested should devolve upon this Commission. But I think not. And the principal reason that I have for thinking that such a body as the Council of the Royal Society is not suitable for the purpose is, that it cannot have that specific responsibility put upon it which should be put upon a body such as I have spoken of, and that it is got together for totally different purposes and objects. The council of the Royal Society has to manage the business of the Royal Society, and is not at all selected to advise the Government on matters connected with the advancement of science, or the application of science in the operations of the public departments."

u. 11,887. "And one-half of their number is changed every year?—Yes."

u. 11,888. "You could not make the minister responsible for the action of the council of the Royal Society, or of its committee?—Not at all."

u. 11,889. "Because the nomination of the council and of the committee is by a body of constituents over whom the minister has no control?—Quite so; the minister would have a perfect right to repudiate any scheme which they put forward, or any advice they gave; I mean that he would be justified in doing so on the ground that he was not responsible for their selection." * * * *

He is in favour of the advice of the Council being made public, as a rule, but subject to the discretion of the Minister.

u. 11,889. "There would be cases, for instance, in which the minister might ask a question as to the relative qualifications of two scientific men for some post, and the commissioners would give an opinion, and their reasons for that opinion, but it would not be right that the grounds on which they formed it should be made public; still, as a rule, the more complete the responsibility put upon everybody connected with the commission for the opinion that he gave on any subject that came before it, the better would it be."

With regard to the Financial Duties of such a Council, he would wish it to prepare Estimates with reference to any expenditure they might propose.

u. 11,890. "They should place any proposals that they had to make in a definite form before the minister, but I would not hand over any lump sum to them as is done now in the case of the Royal Society. I understand that the Treasury give a thousand pounds a year to the Royal Society, to spend in their own way on scientific objects. I think myself that this system is essentially vicious; to make a homely comparison, it is as though I desired to absolve myself from all responsibility in connection with the suffering and poorer class of the community, by giving the first beggar I met sixpence. The Chancellor of the Exchequer hands over a thousand pounds to the Royal Society, and thinks that he has done all that is necessary for the promotion of Science."

He does not propose that the Council should supersede the Scientific Branch of any Public Department; but is of opinion that a Council would strengthen the hands of the responsible Chiefs of such Departments:

"I think that the idea of placing such matters as the construction of ships for the Navy, or the form of guns, or of small arms, or of projectiles, and so forth, upon a body of this sort is altogether a mistake; that is not a function that should be put upon such a body; it is not really what is wanted. The departments of the Government that have to carry out those particular duties are responsible for possessing the necessary knowledge; for instance, the department that builds ships has within its own body all the necessary means of acquiring the information requisite for designing proper ships and for building proper ships, or, at all events, if it has not, it ought to have; and if there is a defect in the organization of those bodies, they ought to remedy the defect themselves; they ought to introduce amongst their officers proper people." Qu. 11,890.

"There is not the slightest reason to doubt that the responsible officers in the Controller's Department knew perfectly well that the "Captain" was not a safe ship, but their opinion was overridden, and if Admiral Robinson and Mr. Reed had had a body of this sort to refer to, if they could have challenged the Admiralty board to take a scientific opinion from this body as to whether their views were right or wrong, great good would have resulted." * * * * Qu. 11,890.

As regards the special use of the Council in reference to the Administration of India, the evidence of this Witness is so full and so important that we must refer to it in extenso at pages 213 and 214, Vol. II. of Evidence.

Captain Galton would desire to see a Council whose duties should be principally administrative.

"I should not advocate the formation of such a council unless that council could be given duties other than those of a consultative nature. I do not believe in mere consultative councils. If a council is to be appointed, it must be a council for some other objects, and I think there is quite sufficient reason for the appointment of a scientific council or commission, or whatever you like to call it, for certain other purposes, and that when it was constituted for those other purposes, which are practically administrative purposes, the council might be advantageously consulted upon other subjects by the Government." Qu. 12,980.

"You have pointed out that there are a very considerable number of Institutions connected with Science which are supported by the State; do you consider that there is sufficient system in the present arrangements?—I think that the institutions which are maintained by the State for scientific purposes are maintained upon no principle whatever with regard to their administration. You have got the British Museum under Trustees, you have got South Kensington under the President of the Council, you have Kew under the Office of Works, you have the Botanic Gardens at Edinburgh, I think, under the Queen's Remembrancer. You have the Observatory at Edinburgh as part of the University of Edinburgh, and you have the Observatory at Greenwich under the Admiralty, besides several others. You have every possible variety of jurisdiction, and, consequently, it seems to me that you have a great waste of power; there is the School of Chemistry, and the School of Mines, and the Museum at Edinburgh, all under South Kensington Museum, and the Meteorological Department, which is partly under the Royal Society and partly under the Board of Trade. There is no possibility of getting any correlation between those different scientific bodies, and if you are to get proper unity of administration you must bring them all under one head, or to one focus. I should recommend placing them all under a scientific commission or council, and I should place that council probably under the Privy Council; but I should make it a body for administering all questions connected with all the scientific institutions, or all grants made by the Government for scientific purposes in the country, and I should give to this Council the same status, with regard to its administration, or very much the same, that the Indian Council have." * * * * The parliamentary head of the Department, if he differed from them in opinion as to their recommendations upon the scientific questions connected with those institutions, or any other that might be founded, should record his differences of opinion in a minute." * * * Qu. 12,984.

'Have you considered what would be the best mode of constituting such a council?—I should keep it to as limited a number as would represent sufficiently the different branches of science. I do not think that you could possibly have a smaller number than five or six. I think they would want a secretary, and, of course, they would have to meet tolerably frequently for the administration of these mattters." Qu. 12,988.

The Council, in his opinion, should be nominated by the Minister of the Department, or the Prime Minister. Qu. 12,989.

He further considers that all questions as to grants of public money for purposes connected with Science should be referred to the Council, instead of being granted or refused "hap-hazard." Qu. 13,000.

Dr. Siemens would "assemble the Heads of Departments at frequent intervals for the " discussion of general questions, and would propose to add to their number such " men as the President of the Royal Society, the President of the Institution of Civil " Engineers, and at least one Representative of the two great Universities. This Board " would decide general questions appertaining to the Advancement of Science." Qu. 11,796.

He would regard the opportunities of meeting together, thus given to Heads of Departments, as one of the great advantages of such a Council. Qu. 11,857.

Qu. 11,800. He thinks that the number of the Council should be about 20, and that the greater part
Qu. 11,801. of its members, being Heads of Departments, should not receive payment as members
Qu. 11,802. of the Council. The four additional members whom he proposes, he considers would
Qu. 11,803. probably decline remuneration.

The Functions of the Council of Science, with regard to Research, would, according to this Witness, be very limited:

> "Would it be desirable, in your opinion, that this Council, or any scientific Government department, should undertake experimental research?—I think not; my impression is that scientific research should be left as free and open as possible. If gentlemen were specially instructed to make experimental research they would be, I consider, in a somewhat false position. They would be morally obliged to produce results in order to satisfy the public mind that they were doing their duty, and science or scientific research cannot be measured by such a standard of results. I consider that a man should always have some absolute duty to perform, some drudgery work, which might be made as light as possible; but my impression is that he would not be in a satisfactory position, either to himself or as regards the public, if discovery were his only duty."
>
> Qu. 11,846. "Your opinion was that the Government should not direct scientific research, but I think I understood you to say that it was desirable that they should direct inquiries to be made in reference to subjects of direct national importance?—Yes."
>
> Qu. 11,847. "And those you think should be carried out chiefly by commissions in each case appointed for the purpose?—Yes, by commissions appointed for the purpose. I think that there should always be a direct practical object in view."
>
> Qu. 11,851. "If those inquiries were directed by a Government council of the nature of the one which you have sketched, do you think that they would be more likely to be successful than if they were left to make their investigations in a more independent way?—I think I would as much as possible leave investigations in the hands of individuals. I would make inquiries through committees or commissions, because they have the means at their disposal for collecting information which private individuals have not."

Qu. 11,858. There should be a Ministry of Science and Education, which would constitute an im-
Qu. 11,860. portant Department of itself, the Minister being the Head of the Council. "There are
" Political Men of highly cultivated minds, or even with a great knowledge of Science,
" who would be quite capable of taking such a position."

Qu. 11,938. Mr. Anderson appears not to be thoroughly convinced of the advantage of a Council.
Qu. 11,939. He thinks there is at present more sound Scientific Knowledge in the Government
Departments and at the disposal of the Government than is generally supposed, but that
if a Council should be appointed, a small number would be better than a large one. He
considers that seven would be sufficient, and admits that without the assistance of some
Qu. 11,941. such Council as this, he sees no "symptom at the present time" of the Government
causing such inquiries to be made as he thinks desirable.

Professor Jellett thinks that every science should be represented on the Council:

> Qu. 12,812. "Supposing there were no person in the council who was qualified to judge; for example, supposing the subject were a medical subject, and you had no medical man upon your council, I think that when you came to discuss the report you would find yourself in some difficulty. You would be almost entirely at the mercy of the irresponsible individual outside who had given the advice."
>
> Qu. 12,815. "Of course I could not carry on the subdivision to any very great length. For example, take the subject that I am myself most conversant with, applied mathematics. I do not want to have a representative of acoustics, or a representative of optics; one representative of applied mathematics would do."

Mr. Milne-Home would have a local Council for the encouragement of Research in Scotland.

> Qu. 12,449. "I understand you to contemplate the establishment of a board solely for Scotland?—Yes, for Scotland solely."
>
> Qu. 12,451. "I think that if the board were formed in England, with sub-committees in Ireland and Scotland, it might answer the purpose, but I do not see how it is possible that gentlemen in London, unconnected with Scotland, can have that knowledge which is desirable with regard to individuals applying for grants. If there were no board of that kind, the London board would require to make inquiry through individuals selected by themselves, and who would not have the same responsibility as persons officially appointed."

Appendix Mr. Justice Grove, who was unable to attend before the Commission, has stated
XVI., his opinion in an interesting letter which we have given in our second volume, Appendix
vol. II., p. 71. XVI. He is "not very sanguine as to the working of such a Council, but thinks the
experiment worth trying."

He fears that "a large or highly paid permanent Scientific Council * * * would lead
" to political intriguing for place; and not the best men of science but the ablest men of
" the world would succeed," and that "scientific men, moreover, are not, as a body, suited
for the work."

He looks upon General Strachey's proposal, "a continuation of the present Commission, permanent as a body but changed as to individuals," as the most hopeful.

He sees no reason "why the members should not be paid a reasonable salary for
" their time and trouble, but would not put this too high, because, if obtained, it
" would lead to the political-interest-making system."

The extracts which follow have more especial reference to the Functions which the various Witnesses propose the Council should fulfil.

The late Professor Phillips:

Qu. 3138. "I think, first of all, it would deal with all questions such as are now presented to the Government Grant Committee."

Qu. 3139. "And would it aid in directing research?—Yes. The Government Grant Committee has very limited means of maintaining anything of a permanent character, and I think, therefore, that this new board would recommend, in a case of that kind which we are discussing with regard to the formation of special observatories, some grant for the purpose of research requiring many years to be continued, and for which apparently it would be very difficult, or next to impossible, to find any other successful mode at present."

Qu. 3140. "Do you consider that any questions regarding the scientific education of the country would come under such a board?—No doubt they would; there would be, I conceive, a very natural alliance between such a great subject as that and the definite prosecution of physical research, but I have limited my own views in the first instance to subjects connected with the teaching, experimenting, and continually observing of physical phenomena."

Qu. 3141. "If such a board were established and got into full work, do you not think that a large part of the time of the members of the board would be occupied in those duties?—I do, indeed."

Sir W. Thomson:

Qu. 10,675. "The main object of such a council would, in my opinion, be to advise the Government on all scientific questions which might come under the attention of the Government, and on all scientific works actually undertaken." * * * *

Qu. 10,689. Another object of the council would be to advise the minister of science in all applications for the expenditure of money to promote scientific investigations. Applications are frequently made to the Government of a singular character which could not be classed; some of those applications may be thoroughly deserving of support, and others may be of a most frivolous character. All such applications should be referred to one responsible council. At present the Government must be very much annoyed by occasional applications, and I have no doubt that the want of a permament responsible and trustworthy adviser or body of advisers to whom all such applications can be confidently referred, must be seriously felt. I may mention as an instance of applications of that kind, the applications made by the British Association for funds for the late and previous solar eclipses. The testimony of the Royal Society and the British Association to the importance of the object was no doubt in this case accepted immediately by the Government as a sufficient certificate that the object was a suitable one for the expenditure of public money. But there are many other applications even by the British Association itself which the Government feel must be referred to some competent adviser.* Then there are many applications made altogether by private individuals for assistance in some department of scientific investigation; those would naturally fall to be all summarily rejected at present, but it would be advisable that they should be handed over to a council of responsible advisers, who would take each case on its own merit."

Qu. 10,690. "Would you be so good as to inform us whether you have formed any opinions as to the best system of appointing such a council?—The council ought to represent the different branches of science, and the practical applications of science. Pure mathematics ought to be represented in the council; mixed or applied mathematics according to the old-fashioned nomenclature as generally understood ought also to be represented; chemistry cannot be shut out; physics must of course be represented and ought to be represented separately; astronomy, both what was formerly called physical astronomy and of course the new science of astronomical physics, ought to be represented. I do not believe that astronomy could be properly represented under one head; astronomical physics must, in my opinion, be separately represented. Geology should be separately represented, and also the various branches of natural history; physiology also, and medical practice in general, should be represented. I have spoken of applied mathematics, I meant rather mathematical dynamics than applications to art and mechanical operations. Then practical applications should be represented, mechanics and mechanical engineering, then again civil engineering and geodesy, mining engineering, statistical inquiries, and the scientific branches of Her Majesty's service ought to be thoroughly represented. Engineer and artillery officers and the navy should be represented both in its navigation department and in the department of seamanship, and the department of gunnery. The mercantile interests of the country and the agriculture of the country ought certainly to be represented. The universities ought to be represented amply—the English universities, the Scotch universities, and the Irish universities. Also practical telegraphy, which is a very distinct branch of engineering, civil engineering or mechanical engineering would not sufficiently represent it."

Qu. 10,750. "Do you think that the functions which are proposed to be assigned to the scientific council would not interfere in any way with the existing scientific departments of the Government; for example, the Medical Department of the Privy Council, or some of the other Government scientific departments?—I think it would relieve the departments from pieces of scientific work at present given to them, because there is no other body to whom they can be given, and for which they are by their organisation and *personnel* almost necessarily ill fitted and insufficiently competent."

Qu. 10,751. "You would leave to these departments their administrative functions, but give them the advantage of consulting with the council upon higher questions of science on which they desired information?—Yes, certainly; every question of science that falls under the notice of any department of the Government would naturally be referred to the scientific council."

Captain Galton:

Qu. 12,984. "I should make it [the Council] a body for administering all questions connected with all the scientific institutions, or all grants made by the Government for scientific purposes in the country, and I should give to this council the same status with regard to its administration, or very much the same, that the Indian Council have; that is to say, that the parliamentary head of the department, if he differed from them in opinion as to their recommendations upon the scientific questions connected with those institutions, or any other, that might be founded, should record his differences of opinion in a minute. Of course as he would be finally responsible to Parliament he must have the final power; but I should put the same check over him that is put over the Secretary of State for India, that he must record his differences of opinion, and his objections to their recommendations, or rather his reasons for not adopting the recommendations of this council, in a written

---

"* As, for example, that for assistance to the Tidal Investigation. See Appendix IX. Vol. II. p. 32."

inute which would be capable of being produced in Parliament if necessary. Of course the remuneration for those scientific gentlemen who would have to give a considerable part of their time to this council, ought to be of a sufficient nature."

Qu. 12,985. "Would you place the management of all the Government institutions connected with science in the hands of this council?—I should place the administration of it in the same way that the administration comes to the different Government departments now. The officers in charge of the British Museum would report to those gentlemen on all expenditure of money, on changes, and other matters of that sort. All their estimates would come up through this council, and all their expenditure would be sanctioned through it, and any questions arising in their administration, for instance, changes recommended, or new regulations, would be administered by this scientific council, instead of being administered by the separate heads of the departments who now administer them."

Dr. A. W. Williamson:

Qu. 12,687. "Could you enumerate what you consider would be the principal duties of this council, supposing it to be established?—I should put the specific duty upon them of preparing a complete report of the national resources available for scientific instruction and research, according to the sense of the word public which I am just now describing it, namely, those which are available for that purpose, and not for the promotion of the profit of individuals; and then that such a report should be re-edited annually, so that one should be able, by referring to it, to know what the funds of the institution are, and what they are doing respectively. I think that it would be of immense value that there should be one general source of information upon that point, and then I have no doubt they would be applied to for many improvements, which would be needed in those institutions; and they would have to investigate the question so brought before them or referred to them by the Secretary of State for that department. I should think it likely that it might be found desirable to refer to this council for advice in the selection of committees to investigate practical matters; for instance, the matter of gunnery, or other matters which are not matters of pure science, and that they would be able to recommend the choice of suitable persons for any work of that kind in which scientific principles would have to be applied to some practical purpose. In fact, the number of questions relating to science which come before the Government now, directly or indirectly, are, I suppose, considerable; and from what I have been able to learn of late on that matter, I should think that a good many people must be incidentally employed, to the extent of a great part of their time, by giving advice upon such matters."

Qu. 12,694. "Then you would not propose that the Government, if it wanted advice upon such subjects, should go to the council of science in order to obtain it?—I conceive that the Government might with advantage go to the council of science in order to find the individuals most competent to advise them upon such a practical point; but I think that the Government ought not to expect advice on such matters from the council itself. I do not see how the council could include matters of that sort with the really important questions of science itself without losing their homogeneity and unity of action. That would include all human activity almost, for scientific principles can be applied to all kinds of doings."

Dr. Roscoe:

Qu. 7438. "The great duty of such a permanent body would be to lay down some sort of system, according to which Government aid to science must be given, and to prevent (if possible) the expenditure of national moneys upon ill-considered or one-sided schemes. The results of a systematic Government effort is seen in the case of the German universities, in which, for comparatively small amounts of national expenditure, great results are obtained, whilst, I fear, that with us (for want of system) the opposite condition of things more nearly holds good."

Qu. 7439. "You would not desire that it should consist solely of men of science?—No, certainly not. I am of opinion that the presence of the lay element is essential, because many questions will occur which are not purely scientific, such as the necessity for establishing new colleges, or aiding existing ones, and on these points the opinions of experienced (perhaps local) non-professional men would be of the greatest value."

Mr. De la Rue:

Qu. 13,091. "Supposing that there had been such a Consultative Council as you propose, would it not have been advantageous to take their advice upon the expediency of such a proceeding?—I think that it would be one of the functions of such a council undoubtedly to advise the Government upon questions of that nature [the purchase of the College of Chemistry by the Government], and with regard to all other scientific matters, grants of money, or the establishment of fresh teaching establishments."

Qu. 13,092. "Then one advantage would be that the public would know on whose advice any such step had been taken by the Government?—Yes."

Dr. Siemens:

Qu. 11,798. "What do you consider would be the principal duties of such a Council?—To name commissioners for special inquiry, to discuss generally the amounts of the grants to be given to learned societies, and to advise the minister with regard to innovations proposed in Government departments. Take, for example, an invention of ordnance; if such a question, after a preliminary examination by the department concerned, were brought before the general body, it could there be discussed for the guidance of the Minister of Science, to ascertain whether such an innovation was based upon sound scientific principles, and what course of experiments should be pursued to lead to the best results. By referring it to the Minister, and having it discussed before such a Council, a great deal of unnecessary expenditure might often be saved where, through the want of sufficient information, the experiments are conducted by the departments in a somewhat unscientific manner. Another duty of the Council would be generally to direct the publication of the scientific information obtained through the different departments."

Qu. 11,799. "Do you consider that it would be the duty of such a Council to initiate proposals on matters connected with Science, or merely to give advice when asked for?—Only to give advice when asked for, but the departments should be held to communicate with the Minister all important questions brought before them, who, with the advice of the Council, would direct inquiries to be instituted in many cases where the department would have simply rejected the proposal."

Mr. Reed :

> “If a department of the Government were contemplated as an advising department only, I believe it would be an impracticability. But it has been suggested to this Commission, I believe, or at any rate I have heard it suggested, that a scientific department might relieve certain existing departments of the State of some of the duties in connection with science and art. If that were so, if a department of the State had positive executive duties to perform, and were to have the promotion of those independent inquiries and the giving of advice to other departments attached to it as a branch of its duty, and not as its primary duty, I am disposed to think that such a department might work exceedingly well.” Qu. 12,711.
>
> “Do you think that the other departments would be willing to defer to the opinion of this special department?—I should be afraid that they would be willing to defer a little too often, and that the risk of such a department would be in a branch like the Admiralty, for instance, refusing to do some of the things which it now does, without first referring to this independent department, and that I am afraid would be an obstruction to the executive officers of the Admiralty; and unless the department were exceedingly well worked, it might operate as a disadvantage on the whole.” Qu. 12,712.
>
> “I should prefer myself to see a much smaller council with a larger power of reference than Colonel Strange seems to contemplate.” Qu. 12,715
>
> “By a power of reference, you mean that of obtaining advice outside itself?—Yes.” Qu. 12,716.

Extracts from the Evidence against the Appointment of a Council.

We now proceed to give extracts from the Evidence of those Witnesses who object, on various grounds, to the creation of a Council.

The late Professor Rankine objects to a Permanent Council. He is “afraid of abuses Qu. 9557. arising if there were a permanent tribunal. I am doubtful how it would work.” But he thinks that “if the Council of the British Association or the Council of the Royal Qu. 9558. “Society were selected, there would be as little objection to those bodies as to any “body that can be thought of.”

Sir G. Airy thinks a paid Consultative Council could not do very much to assist the Government.

> “There have been bodies of that kind from time to time. The Board of Longitude was a very useful body for a time, when the struggle was rising about accepting the theory of gravitation and generally introducing it, especially into the formation of lunar tables for the aid of nautical astronomy, and also the subjects connected with it; and that Board of Longitude undoubtedly did good service for a time, but somehow or other it died away; it became an object of contempt; there appeared no reason for keeping it up at any expense and it was abolished, and nobody seemed to regret it. Then the Admiralty had an institution of three scientific advisers, but I believe the scientific advisers perished in nearly the same way after a time; and I think that so far as the experience of those bodies has gone it supports the idea that it will be better for the Government, when occasion requires it, to get the best advice that it can.” Qu. 10,522.

He considers that the Council of the Royal Society would be “the best body Qu. 10,544. to which the Government could have recourse in any matters of that kind.”

Professor Owen is in favour of a Minister of Science, with a permanent Under-Secretary and Administrative Staff; but adds,—

> “With regard to the Consultative Council, several objections occurred to me in considering that matter. The consultative council would, no doubt, be formed with the full concurrence, and in complete harmony with the views of the Permanent Under-Secretary. You may take it either way; a consultative council, if it were established, would hardly get on with its work, unless it found a permanent officer in harmony with its views. Assuming the Permanent Under-Secretary with a consultative council established, what would be the probability of the Minister going beyond such machinery in reference to any information or advice which he might require with regard to any movement or change in reference to science? I doubt very much whether he would go outside or beyond that body for advice and information. And what do you find? You find, for example, in reference to my own especial science, one Naturalist on the recommended Council. Now there are, and I suppose there always will be, three or more naturalists who might each severally think that they were entitled to a seat and a word on that Council. You would find two naturalists, at least, who are respectively at the head of some public Natural History Establishment; one might have a bias toward zoology, another toward botany, a third, perhaps, toward geology. Supposing a question were to come before the Science Minister with regard to the assignment of Government collections of Natural History made in Government Voyages, where would the determination be?—In all probability with that naturalist who was a member of the consultative council, and such position would give him, in my humble opinion, an undue advantage.” * * * Qu. 11,537.
>
> “Supposing that a single naturalist were a member of that council, the question would be whether, in a case of this kind, he would deal quite impartially between Mr. * * * * * and Mr. * * * * *, and so with regard to any other analogous case; it is always uncertain how far social relations of friendship, and intimacy, and so on, might not have their effect in such a question.” Qu. 11,538.

He does not approve of the present state of things, but he thinks that a Minister and Qu. 11,551. a permanent Secretary, who could obtain Advice when thought necessary, would be a better remedy than a consultative Council. He adds, “I think that a body, representing “a consultative Council, would do its duty much better if selected by the Minister of Qu. 11,553. “Science, or the Minister of State for Science, for the special question before him,” and also suggests :—

> “There would be the power of applying to the councils of the different scientific societies, the council of the Linnæan Society for one, the council of the Geological Society for another, and the council of the Zoological Society for a third class of questions in natural history, to say nothing of the council of the mother of all our learned societies, viz., the Royal Society; in these we have already a guarantee against any dictatorship or arbitrary decision.” Qu. 11,559.

The Earl of Derby would like to be more satisfied as to the reality of the grievance:

Qu. 13,514. "I do not, as at present advised, see what the difficulty is of obtaining the best scientific assistance when any Government department chooses to call for it. As a matter of fact the names of the most eminent men in every department of science are perfectly well known, and they have always, as far as I am aware, been very creditably ready to give their assistance when it has been asked for; and I should be inclined to think that if there are cases where a Government department has not had the benefit of that assistance, it has rather been because it was not asked for in time than because there was any difficulty in obtaining it."

Qu. 13,515. His Lordship also is "very sceptical either as to the necessity, or as to the utility, or "as to the successful working of such a Council."

"One objection to it is that if matters for which the head of a department is responsible are to be referred to the council, and if upon those matters the council is to pronounce an authoritative opinion, you will very materially lessen the responsibility of the one person who ought to be responsible to Parliament. I may take an instance: I have seen it stated in some of the evidence which has been given before the Commission that if the Admiralty had had proper advice as to the construction of ships, a great disaster which is fresh in all our memories would not have occurred. It seems to me impossible to suppose that you would get any competent person to advise the Admiralty in the matter of shipbuilding if he were to be under two masters, that is to say, if his plans were to go, on the one hand, to a scientific council to be approved by them, they having nothing to do with the question of expense, and, on the other hand, to go to the head of that department and to Parliament to be approved again by those two parties, they having nothing to do with the science of the matter, but looking principally to the expense. I think that that would entirely destroy the responsibility of the executive officer, and would destroy that independence which he ought to have in the performance of his functions. If you want scientific advice in a matter of that kind I would place it in the department rather than outside, or, which is practically the same thing, I would refer the specific question upon which the opinion is wanted to one or more of those persons who could bring the highest scientific authority and ability to bear upon it. It strikes me further that if you are to have a council including all the departments of science, and if that council is to pronounce its opinion collectively upon all matters submitted to it, you will in fact have every question decided by a great majority of persons who, however eminent in their own department of science, know very little of the particular matter in question."

Qu. 13,517. In reply to the suggestion that "One function [of the Council] would probably be, "to advise the State as to the application of money for the higher teaching of science and "for scientific research, and also to advise the Government with respect to any applica-"tions that may come before it for grants of money connected with science," Lord Derby thinks that "is a matter which falls strictly within the province of the Minister of
Qu. 13,519. Education;" and although he is quite aware of the fact that "if one man is selected as "the general adviser of some particular department of the Government upon a matter "of science, it is not improbable that there may be some jealousy in the minds of certain "other people who think that they could give quite as good advice, or possibly better;" it seems to him that "unless the proposed Council is to be unlimited in number, pre-"cisely the same difficulty will arise under that system. There will be a large number of "persons outside it who will think that they have a better claim to be in it than those "who actually are there; and precisely the same feeling of jealousy would then exist, "and would produce the same amount of inconvenience."

Qu. 13,521. In reply to qu. 13,521, he adds, "you may be quite sure that any Minister who "wants an opinion upon a scientific matter will try and get the very best opinion that "he can. He has no possible interest in doing otherwise; on the contrary, he has the "greatest possible interest in doing that. And, on the whole, I think that a man in that "position, with what I may call an unlimited command of assistance and advice, is quite "as likely to make a good selection as anyone else could do for him."

Qu. 13,522. He does not admit the analogy of the Indian Council, and as regards the argument from the alleged uncertainty of Government action in respect to Science, more especially as to Grants of Money, he thinks this arises chiefly from considerations depending upon the state of the Revenue in each year, and expresses his opinion that "it might be
Qu. 13,540. "quite legitimate to grant 4,000*l*. or 5,000*l*. for exploration in Africa at a time when the "finances of the country were prosperous, and to withhold a similar grant at a time "when the nation was economizing to the utmost."

He admits that, even apart from financial considerations, a great deal of uncertainty
Qu. 13,541. "pervades the whole of our administrative system;" and is "an inevitable condition of "living under a popular government."

He further urges the following objection to the proposal of a Scientific Council on a large scale:

Qu. 13,550. "I believe that you would have a great deal of heartburning and jealousy on the part of men desiring and failing to get into it; and I think that if you brought together 25, 30, or 40 of the most eminent men in science, it would be found that the practical direction of that body would very likely be in the hands of men who are by no means the highest scientific authorities. The conduct of administrative business and the management of men is an entirely different thing from the conduct of scientific research, and it might very possibly be that those who would take the lead in managing the affairs of such a council would be those whose time and attention were the least devoted to purely scientific work, and who although they might possess a good deal of administrative ability might possibly not by any means stand at the heads of their respective branches of science."

With regard to the proposal to constitute the Council of the Royal Society the recognised advisers of the Government, he expresses the opinion that it would not be possible to refer "matters concerning all branches of science to a more competent body " of men than the Council of the Royal Society, constituted as it generally is." But he adds, "My objection to giving to that body an officially recognised position as the " permanent Advisers of the State is this, that you thereby take it out of the power of " the Government to say who their advisers are to be, because the members of council " are appointed by a process with which the Government has nothing to do." Qu. 13,551.

Lord Salisbury is opposed to a Council because he has "never seen anything to lead him to believe that such a Council of Science would have anything to do." Qu. 13,560.

He further thinks "that the Government would always get better opinions, on any " scientific point that arises, by applying to the most distinguished scientific man in that " particular branch at the time, than it would by having a set of permanent officers to " give advice on such subjects." * * * * Qu. 13,566.

In answer to qu. 13,563, he says that "it could hardly be contemplated that any such " Council could give a stability to the Policy of the Government in matters connected " with Science, because, of course, the stability of the policy of the Goverment depends " upon the stability of our whole political arrangements;" and (qu. 13,564) "the " House of Commons would never feel itself prevented from reversing the decision of a " Council of Science of that kind."

Lord Salisbury agrees with Lord Derby, in not considering the Council of India a case in point; he explains that "a veto has been lodged with this Council, enabling them to " prevent any expenditure of which they disapprove. But no similar difficulty arises in " questions of science. There are no large sums of money arising from the taxes of a " distant people that have to be expended, and, therefore, no special check is required " upon Ministers with regard to that matter. * * * Besides that, the Indian Council, " beyond its checking power, is really simply a bureau of administrators. The councillors " act as under-secretaries." * * * * Qu. 13,565.

He thinks that on many points on which a Minister might refer to the Council for advice, there might be reason to apprehend "a series of minority reports."

> "Supposing a council of 12 or 16 scientific men: although undoubtedly upon a great number of matters they would be unanimous in opinion when they were dealing with that which is known and accepted as scientific fact, yet on all the border points between knowledge and speculation their opinions would most probably differ, and the position of a minister who had before him two or three sets of opinions, in entirely opposite directions, would not be much more hopeful than that of a minister at present who has no opinions at all." Qu. 13,582.

> "Whatever errors there may be in the opinions of one individual, at least they have an unity and a courage which is very often wanting to the compound opinion of a dozen men." Qu. 13,583.

He attaches no importance to the supposed advantage arising from the advice of a Council being subject to public opinion to a greater extent than that of individuals; considering that the admission of reporters would be a hindrance to business, while without their presence "the public at large would know very little of its proceedings;" and in reply to qu. 13,600, "I think that what has been proposed by the Witnesses who " recommend a Council is, that in every case in which an opinion is asked they should " furnish a Report of the reasons for the advice which they give?" he expresses fears, " that if the Council were constructed on that principle, the Ministers, who usually have " their time very fully occupied, and are desirous to avoid work as much as possible, " would consult the Council as little as possible." Qu.13,595–6 Qu. 13,600.

So far as the mere Administration of Funds granted by the State for Scientific Purposes is concerned, he is of opinion that no better channel than the Government Grant Committee of the Royal Society could be found.

> "There is no body which is so thoroughly well constituted for the purpose of representing the scientific world as the Committee of the Royal Society." Qu. 13,603.

> "You prefer that to any new-fangled scientific council?—Yes, certainly. We know how it works, and it would be pretty sure to go on working as well as it does now." Qu. 13,604.

The Evidence of Sir Stafford Northcote is to the same general effect as that of Lord Derby and Lord Salisbury:

> "My own leaning would be to throw the responsibility, as now, upon the heads of the different departments, leaving them to get the best scientific assistance they could, but providing for the maintenance of such relations between the Government and some scientific body external to the Government, such as the Royal Society, perhaps, as would enable the Government to take advice from that society as to the best men to consult, and also as to the possibility of the work that was proposed to be undertaken." Qu. 13,635.

> "I should have thought that some kind of payment might be made to the society, which the society might expend, and by employing such officers as it thought proper to keep all the correspondence, and to refer it to the proper persons; and then, my idea would be, that supposing at the Board of Trade, for instance, some Qu. 13,636.

new question arose upon which scientific information was wanted, the President of the Board of Trade would write to the Council of the Royal Society, and would say, such and such business has to be done, and I want such and such advice. Then the secretary, or whoever it might be, would bring the subject before his council, and would write back, What you propose appears to be feasible; you ought to consult Mr. so-and-so, or professor somebody, and you would then be placed by an independent authority in direct relations with the proper man to deal with the subject. Then it would be a question of remunerating that gentleman by a fee as you would remunerate a lawyer by a fee, for the service which he was to render."

Qu. 13,637. He thinks that a Council "would cause jealousy on the part of the Departments; and that it would also very likely cause jealousy on the part of other men of Science."

"I feel sure that there would be a great deal of jealousy on the part of the departments if any council were appointed to regulate the conscience of the Government in scientific matters, and to say how money ought to be spent, what money ought to be spent, and what ought to be done, and what ought not to be done." * * *

"With regard to that case of which I was speaking, of the School of Design, I know that there was very great jealousy at that time. The organization of that council was this:—A certain number of eminent architects, sculptors, and painters, and other persons were put upon [the Council], and they partly fell out among themselves, and then it was necessary for the President of the Board of Trade, who was responsible for the spending of the money, to side with one party or the other, and to decide what was to be done, which he was, of course, not very competent to do. Then came a great deal of external jealousy on the part of the other artists whose views were set aside, and there was, at the same time, a good deal of jealousy on the part of the Board of Trade, it being told that because these artists held this and that, therefore they were to spend the public money in this way or the other way."

And he speaks of similar jealousies as having arisen between the Committee of Military Sanitary Organization and the Military Members of the Indian Council:—

"Similarly, I might mention as an instance in which I saw the germs of jealousy, the Committee of Military Sanitary Organization, which is referred to, I see, by Captain Galton in his evidence. Whilst I was at the India Office it was perfectly true that a great many questions were referred to that Committee, and they gave very valuable advice, but I could see that there was a great deal of jealousy on the part of those who were the military members of the Council of India of the interference, as it was said, of this Sanitary Committee. The military members said, 'We are the people who are responsible for the spending of the money and for 'doing what is to be done, we do not see why those gentlemen, who have nothing to do with that, are to 'dictate to us; and we will not accept their suggestions.' Then would come from the Sanitary Committee remonstrances, and they would say, 'We have special knowledge of this subject; it is what we are paying 'attention to; and we think it very wrong that you should not attend to our suggestions, and that you should 'spoil what we are doing.'" * * * *

At the same time he does not agree with Lord Salisbury in his approval of direct reference by the Minister to an individual.

Qu. 13,647. "I do not like the present system of applying to irresponsible advisers, and I should desire to see some more systematic mode of proceeding adopted."

In reference to one of the proposed functions of the Council, that it should advise the Government on the Management of Institutions like the Meteorological Office, the British Museum, and the Royal Gardens at Kew, he would still prefer the advice of a body not appointed by the Government.

Qu. 13,654. "I doubt whether such a council would either command public confidence very long, or command the respect which it should have from the Government itself, if it were a creation of the Government. You might appoint in the first instance some very eminent men. Probably you would not get a great many of the most eminent men to give a great deal of time to work of that sort, and you would have to take those who were willing to spare the time necessary for the discharge of the duties of the council. They would continue for some time in office, and they would adopt certain ideas, and their constant contact with the Government would rather lead them to say, 'This sort of thing cannot be done,' because they would take into consideration administrative points, and would not give purely scientific advice. They would, therefore, cease to possess the confidence of the public outside. There would also be more eminent men who would say, 'These are old 'women who are going on in a certain routine, and we do not attach much value to what they say.' And, on the other hand, they would not have the same advantageous independent position for offering advice or making suggestions to the Government which a body recruited *ab extra* from the scientific world would have."

Upon the suggestion that a Council advising on the Advancement of Science should also advise on Scientific Education, he remarks:

Qu. 13,656. "I think that it would be very desirable that the Council of Education, or the Minister of Education, should have the advice of good scientific persons to assist him in directing the scientific education of the country; but I should doubt its being very advantageous to mix up that work with the other kind of duties to which you have referred."

Dr. Carpenter's Evidence is also in favour of recourse to the Council of the Royal Society whenever the Government requires advice on subjects involving questions of Science.

Qu. 10,931. "I think that there is a great advantage in having any question of that kind discussed, not merely by the representatives of one department of science, but by the representatives of the scientific body generally,—the *corps scientifique* of the nation. Under the present constitution of the Royal Society, the Council of the Royal Society may be regarded as a very true representative of the scientific life, so to speak, of the nation. It would doubtless, if it saw occasion, seek the advice (as it does at present in the administration of the Government Grant) of competent men outside its own body."

But he considers that "the present state of things" is unsatisfactory in so far as "there is no Systematic Arrangement for the Promotion of Science." Qu. 10,934.

Sir E. Sabine, President of the Royal Society for many years, appears, on the whole, to incline to the opinion that it would be best that the Royal Society should remain the official adviser of the Government in scientific matters; suggesting, however, that in particular cases "Special Committees might be appointed with such emoluments as it "might be proper to recommend." Qu. 11,122. His Evidence contains some interesting statements relating to the Board of Longitude, which formerly existed, and which he acknowledges to have rendered "valuable services to the country during the period of its existence," Qu. 11,129. matters being frequently referred to it which it was admirably adapted to judge of.

REMARKS ON THE FOREGOING EVIDENCE RELATING TO THE ESTABLISHMENT OF A MINISTRY AND COUNCIL OF SCIENCE.

We have given careful consideration to this part of the Inquiry entrusted to us; and, in the course of our deliberations, we have been led to attach much importance to the facts stated in the First Part of our Report, which show that the Scientific Work of the Government is at present carried on by many different Departments.

There is nothing to prevent analogous, if not actually identical, investigations being made in each of these, or to secure to one department an adequate knowledge of the results obtained, and the circumstances under which they were obtained, by another.

Investigations admitted to be desirable, nay, practical questions, the solution of which is of the greatest importance to the public administration, are stated by the witnesses to be set aside because there is no recognised machinery for dealing with them; while, in other cases, investigations are conducted in such a manner as to involve a needless outlay of time and money, because they were originally planned without consultation with competent men of Science.

Passing to the question of the Advancement of Science, we have arrived at the conclusion that much has to be done which will require continuous efforts on the part of the Administration unless we are content to fall behind other Nations in the Encouragement which we give to Pure Science, and, as a consequence, to incur the danger of losing our pre-eminence in regard to its Applications.

These considerations, together with others which have come before us in the course of our Inquiry, have impressed upon us the conviction that the Creation of a Special Ministry dealing with Science and with Education is a Necessity of the Public Service.

This Ministry would be occupied (1) with all questions relating to Scientific and General Education, so far as these come under the notice of Government; (2) with all questions incidental to the application of National Funds for the Advancement of Science; and (3) with all Scientific Problems in the Solution of which the other Departments may desire external Scientific Advice or Information. It would also be desirable that the Department should receive Information as to Scientific Investigations proposed by other branches of the Government, and record their progress and results.

It is not within our province to express an Opinion as to whether the subject of Art should be included among the Functions of this Department; but we are satisfied that the Minister's attention should not be distracted by any immediate Responsibility for affairs which have no connexion with Science, Education, or Art.

We have considered whether the Official Staff of such a Ministry, however carefully selected, could be expected to deal satisfactorily with all the varied and complicated Questions which would come before the Department. We have given full weight to the Objections which have been raised against the creation of a Special Council of Science, and to the Arguments in favour of referring Scientific Questions to Learned Societies, or to Special Committees appointed for the purpose, or to private Individuals; but nevertheless we have arrived at the Conclusion that an additional Organization is required through which the Minister of Science may obtain Advice on questions involving Scientific considerations, whether arising in his own Department or referred to him by other Departments of the Government.

Such questions have from time to time been referred to the Council of the Royal Society, in which the best Scientific Knowledge of the time is fairly represented. The Committee chosen by that Council for the Administration of the Government Grant of 1,000*l*. per annum in Aid of Scientific Investigations has performed its work to the satisfaction of the Government, of men of Science, and of the Public. But if much more is to be done for the Advancement of Science than at present, and if the Departments in conducting their Investigations are to have the benefit of the Scientific Advice which appears now to be frequently wanting, the Council of the Royal Society, chosen as it is for other purposes, could scarcely be expected to take upon itself Functions which, it is true, are not different in kind, but which would involve increased Responsibility and the Expenditure of additional time and trouble. Moreover, amongst the questions on which the Departments would require Scientific Advice, there would no doubt be many requiring a Knowledge of the peculiar exigencies of the Public Service, which would be more readily understood and solved if some persons in direct relation with the Departments formed a part of the body to be consulted. It is obviously of great importance that the Council should be so constituted as to possess the confidence of the Scientific World, and we believe that this confidence would be extended to a Council composed of men of Science selected by the Council of the Royal Society, together with Representatives of other important Scientific Societies in the United Kingdom, and a certain number of persons nominated by the Government. We also believe that such a Body would deserve and receive the confidence of the Government; and that it would be well qualified to administer Grants for the Promotion of Pure Science.

The general opinion we have expressed as to the proper Remuneration of Scientific Work would be applicable to the Members of this Council, but the degree and manner in which the principle should be applied in this instance must be so largely dependent on circumstances that we cannot make any specific Recommendation on the subject.

It would be impossible that the Council should in all cases undertake the direct solution, by itself or even by Sub-Committees, of the problems submitted to it. In many instances, especially when experimental investigations are required, its duty would be accurately to define the problem to be solved, and to advise the Minister as to the proper persons to be charged with the Investigation.

We are of opinion that the Council should not have the power of initiating Investigations; it should, however, not be precluded, in exceptional cases, from offering to the Minister such suggestions as it may have occasion to make in the Public Interest.

We believe that Reference to such a Council would be found to be so useful and convenient that it would become the usual course in cases of difficulty, but we would not diminish the Responsibility or fetter the Discretion of any Minister by making such Reference obligatory, or by preventing a Reference to Committees or to Individuals chosen by him, whenever that course might appear to him to be more desirable.

Conclusions and Recommendations.

I. The Assistance given by the State for the Promotion of Scientific Research is Inadequate, and it does not appear that the Concession or Refusal of Assistance takes place upon sufficiently well defined Principles.

II. More complete means are urgently required for Scientific Investigations in connexion with certain Government Departments; and Physical as well as other Laboratories and Apparatus for such Investigations ought to be provided.

III. Important Classes of Phenomena relating to Physical Meteorology, and to Terrestrial and Astronomical Physics, require Observations of such a character that they cannot be advantageously carried on otherwise than under the Direction of the Government.

Institutions for the study of such Phenomena should be maintained by the Government; and, in particular, an Observatory should be founded specially devoted to Astronomical Physics, and an Organization should be established for the more complete Observation of Tidal Phenomena and for the Reduction of the Observations.

IV. We have stated in a previous Report that the National Collections of Natural History are accessible to Private Investigators, and that it is desirable that they should be made still more useful for Purposes of Research than they are at present. We would now express the opinion that corresponding Aid ought to be afforded to Persons engaged in important Physical and Chemical Investigations; and that whenever practicable such persons should be allowed access, under proper limitations, to such Laboratories as may be established or aided by the State.

Fourth Report.

V. It has been the practice to restrict Grants of Money made to Private Investigators for Purposes of Research to the Expenditure actually incurred by them. We think that such Grants might be considerably increased. We are also of opinion that the restriction to which we have referred, however desirable as a general rule, should not be maintained in all cases, but that, under certain circumstances and with proper safeguards, Investigators should be remunerated for their time and labour.

VI. The Grant of 1,000*l.*, administered by the Royal Society, has contributed greatly to the Promotion of Research, and the amount of this Grant may with advantage be considerably increased.

In the case of Researches which involve, and are of sufficient importance to deserve, exceptional expenditure, Direct Grants in addition to the Annual Grant made to the Royal Society should be made in Aid of the Investigations.

VII. The proper allocation of Funds for Research; the Establishment and Extension of Laboratories and Observatories; and, generally, the Advancement of Science and the Promotion of Scientific Instruction as an essential part of Public Education, would be most effectually dealt with by a Ministry of Science and Education. And we consider the creation of such a Ministry to be of primary importance.

VIII. The various Departments of the Government have from time to time referred Scientific Questions to the Council of the Royal Society for its Advice; and we believe that the work of a Minister of Science, even if aided by a well-organized Scientific Staff, and also the work of the other Departments, would be materially assisted if they were able to obtain, in all cases of exceptional importance or difficulty, the Advice of a Council representing the Scientific Knowledge of the Nation.

IX. This Council should represent the chief Scientific Bodies in the United Kingdom. With this view its composition need not differ very greatly from that of the present

Government Grant Committee of the Royal Society. It might consist of men of Science selected by the Council of the Royal Society, together with Representatives of other Important Scientific Societies, and a certain number of persons nominated by the Government. We think that the Functions at present exercised by the Government Grant Committee might be advantageously transferred to the proposed Council.

All of which we humbly beg leave to submit for Your Majesty's Gracious Consideration.

(Signed) DEVONSHIRE.
LANSDOWNE.
JOHN LUBBOCK.
JAMES P. KAY-SHUTTLEWORTH.
BERNHARD SAMUELSON.
W. SHARPEY.
THOMAS H. HUXLEY.
G. G. STOKES.
HENRY J. S. SMITH.

J. Norman Lockyer,
Secretary.

June 18th, 1875.

APPENDIX TO EIGHTH REPORT.

APPENDIX .

EXTRACTS from the ESTIMATES for the FINANCIAL YEAR 1874–75.

TOPOGRAPHICAL SURVEY.

	£	£
Pay and extra pay of, and allowances to, staff	7,002	
Extra pay, and allowances to non-commissioned officers and sappers	15,700	
Pay, &c., of Civil assistants, meresmen, and labourers	95,068	
Travelling expenses	3,425	
Fuel, light, &c.	1,700	
Stores	4,250	
Contingencies	4,855	
Civil Service Estimates.)		132,000

HYDROGRAPHICAL SURVEY.

	£	£
Salaries, wages, and allowances, Hydrographical Department	8,480	
Drawing, engraving, printing, and mounting charts	11,000	
Instruments, repairs, chart boxes, &c., books, and contingencies	1,000	
Coast and other surveys (hire of ships, extra pay, &c.).	26,500	
Pay to the Officers and Crews of Her Majesty's ships and vessels employed in the surveying service; also the pay of those employed in hired vessels and boats, but borne on the books of Her Majesty's ships	40,728	
Victuals, &c., for ditto	12,280	
Stores, machinery, and coals supplied to surveying ships and vessels, and also repairs	31,720	
Medicines, &c., supplied to ditto	153	
Pilotage of ditto	50	
	131,911	
In these figures is included an additional sum of 10,856*l*. (over and above the ordinary requirements of the service) to provide for the employment of Her Majesty's ship "Challenger," on a voyage of Scientific Research round the world	10,856	
(Navy Estimates.)		121,055

GEOLOGICAL SURVEY OF THE UNITED KINGDOM.

	£	£
ENGLAND :—		
Salaries	11,589	
Travelling	1,800	
Incidental expenses	250	
SCOTLAND :—		
Salaries	3,065	
Travelling	450	
Incidental expenses	220	
IRELAND :—		
Salaries	4,376	
Travelling	970	
Incidental expenses	200	
(Civil Service Estimates.)		22,920

ASTRONOMY.

	£	£
ROYAL OBSERVATORY, GREENWICH :—		
Salaries, wages, and allowances	3,914	
Contingencies	1,728	
(Navy Estimates.)		
EDINBURGH OBSERVATORY :—		
(Civil Service Estimates)	690	
OBSERVATORY AT THE CAPE OF GOOD HOPE :—	3,371	
(Navy Estimates.)		9,703

METEOROLOGY.

	£	£
METEOROLOGICAL COMMITTEE :—		
Appointed to conduct Meteorological Observations and Experiments on behalf of the Government	10,000	
(Civil Service Estimates.)		
ROYAL OBSERVATORY, GREENWICH :—		
Salaries, Magnetic and Meteorological branch	805	
Contingencies	416	
(Navy Estimates.)		
MAGNETICAL AND METEOROLOGICAL DEPARTMENT, WOOLWICH :—		
For the Reduction and Publication of Observations:		
Salaries	446	
Contingencies	150	
(Army Estimates.)		
ROYAL OBSERVATORY, EDINBURGH :—		
Allowance for Meteorological work	115	
(Civil Service Estimates.)		
REGISTER OFFICE, GENERAL, ENGLAND :—		
Reports of Meteorological Observations furnished to the Registrar General	150	
(Civil Service Estimates.)		12,082

BOTANY.

	£	£
ROYAL BOTANIC GARDENS, KEW :—		
Establishment	3,714	
Travelling	40	
Clothing	85	
Police	1,170	
Works	537	
Maintenance	11,250	
Furniture	250	
Rents	46	
Rates	300	
Contingencies and incidental expenses	180	
(Civil Service Estimates.)		17,572
EDINBURGH BOTANIC GARDEN :—		
Allowance for the Royal Botanic Garden	1,400	
Allowance to the Regius Professor of Botany in lieu of a house	120	
Salary of the Curator	230	
(Civil Service Estimates.)		1,750

BOTANY—*cont.*

	£	£
BOTANIC GARDENS, DUBLIN:—		
Salaries and wages - - -	1,598	
Incidental expenses, including purchase of seeds and plants	550	
(Civil Service Estimates.)		2,148
		21,470

STANDARDS DEPARTMENT OF THE BOARD OF TRADE.

	£	£
Salaries - - - - -	1,383*	
Incidental expenses - -	680	
(Civil Service Estimates.)		2,063

[* In addition to this sum, there are the salaries of two Third Class Clerks and two Supplementary Clerks, at present employed in this Department.]

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

ROYAL COMMISSION

ON

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

Vol. III.

Minutes of Evidence, and Appendices;

Analyses of Evidence;

Index to the Eight Reports (with their Appendices) issued by the Commission,

AND

The General Index to the Evidence; to the Analyses of the Evidence; and to the Appendices to the Evidence given in Vols. I.—III.

Presented to both Houses of Parliament by Command of Her Majesty.

LONDON:
PRINTED BY GEORGE EDWARD EYRE AND WILLIAM SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.
FOR HER MAJESTY'S STATIONERY OFFICE.

1875.

[C.—1363.] *Price* 1s. 5d.

CONTENTS.

PAGE

LIST OF WITNESSES - - - - - - - - - iii

MINUTES OF EVIDENCE - - - - - - - 1

APPENDICES - - - - - - - - - - *1*

ANALYSES OF THE EVIDENCE CONTAINED IN THIS VOLUME - *7*

INDEX TO THE EIGHT REPORTS (WITH THEIR APPENDICES) - - *13*

GENERAL INDEX TO THE EVIDENCE; TO THE ANALYSES OF THE EVIDENCE; AND TO THE APPENDICES TO THE EVIDENCE IN VOLS. I.—III. - - - - - - - - - *25*

LIST OF WITNESSES.

—	Questions.	Pages.
Wednesday, 22d April 1874.		
Robert H. Scott, Esq., M.A., F.R.S. - - - -	13,861–14,020	1–15
Thursday, 23d April 1874.		
Balfour Stewart, Esq., LL.D., F.R.S. - - - -	14,021–14,114	15–22
Tuesday, 28th April 1874.		
The Rev. Robert Main, M.A., F.R.S. - - - -	14,115–14,210	22–31
Major-General Richard Strachey, R.E., F.R.S. - - -	14,211–14,301	31–37
Wednesday, 29th April 1874.		
Alexander Buchan, Esq., F.R.S.E. - - - -	14,302–14,380	38–46
Tuesday, 5th May 1874.		
Robert H. Scott, Esq., M.A., F.R.S. - - - -	14,381–14,496	46–56
James Glaisher, Esq., F.R.S. - - - - -	14,497–14,553	56–60
Tuesday, 12th May 1874.		
Deputation from a Committee appointed to promote the Extension and Improvement of the Buildings of the University of Edinburgh, consisting of Principal Sir Alexander Grant, Bart. - - - Professor Wilson - - - - - Professor Turner, and - - - - - Mr. R. Bruce Johnston, *Secretary*, - - - And accompanied by The Right Honble. Lyon Playfair, C.B., M.P. - -	—	60–63

MINUTES OF EVIDENCE

TAKEN BEFORE THE

ROYAL COMMISSION

ON

SCIENTIFIC INSTRUCTION AND THE ADVANCEMENT OF SCIENCE.

No. 6, Old Palace Yard, Westminster, Wednesday, 22nd April 1874.

PRESENT :

THOMAS HENRY HUXLEY, Esq., LL.D., Sec. R.S., IN THE CHAIR.

SIR JAMES PHILLIPS KAY-SHUTTLEWORTH, BART.
WILLIAM SHARPEY, Esq., M.D., F.R.S.
HENRY JOHN STEPHEN SMITH, Esq., M.A., LL.D., F.R.S.

ROBERT H. SCOTT, Esq., M.A., F.R.S., examined.

R. H. Scott, Esq., M.A., F.R.S.

22 April 187

13,861. (*Chairman.*) You are, I believe, the Director of the Meteorological Office ?—I am.

13,862. The Meteorological Office was originally under the Board of Trade, was it not?—There was a Meteorological Department under the Board of Trade, but the title of Meteorological Office has been given to it since the change in the administration of the office.

13,863. When was that Department of the Board of Trade instituted ?—I think in the year 1854 ; it was the result of the Brussels Conference in 1853, and the whole account of the preliminary negociations are to be found in certain Notes submitted by Sir Edward Sabine to the Royal Society, which are printed in the 15th volume of their Proceedings. The Report of a Committee appointed to consider certain questions relating to the Meteorological Department, Board of Trade, is before the Commission. That report, which was presented to the Government in 1866, and on which, as a basis, the present office has been constituted, says, "The Meteorological Department of the " Board of Trade was subsequently constituted under " the authority of Mr. Cardwell, then President of " the Board, and the late Admiral FitzRoy was ap- " pointed as its head." The precise date of the formation of the original Department I can procure if necessary, it was about September 1854.

13,864. What were the steps which preceded the transfer of the Meteorological Department of the Board of Trade to its present management ?—When Admiral FitzRoy died, the opinion of the Royal Society was asked as to the future management of the Department, whether it had done its work, and whether it was to go on, and the Royal Society recommended that an inquiry should be held, as there was no information before them upon which to form an opinion. Sundry negociations were then carried on, and the result was that a Commission of three members was appointed by the Government. Of those members one was nominated by the Government, or rather by the Board of Trade, being Mr. Farrer, another by the Admiralty being Captain Evans, Chief Naval Assistant to the Hydrographer, and the third was Mr. Francis Galton, who was nominated by the President and Council of the Royal Society. They then held an investigation into the office, and their Report was presented to Parliament. I believe copies of it are in the hands of the Commission.

13,865. The office was then organised in consequence of the Report of that Commission ?—The Commission recommended that the management and control of the office should be handed over to a scientific body.

13,866. Was the organization of the office as it at present exists the result of the report of that Commission ?—Yes ; the Royal Society were then asked if they would consent to undertake the control, and the whole of the correspondence is printed in Parliamentary Paper, No. 240, of Session 1867.

13,867. In what sense do you mean that the Royal Society were asked if they would undertake the control; has the Royal Society at present any sort of control over the Office ?—The Royal Society has not, but it was asked whether it would appoint a Committee who should control it under the Government. In fact, the position is perfectly anomalous; the Government considers us under the Royal Society, and only lately the senior Secretary of the Royal Society has told me that he always considered us under the Board of Trade ; but the Government distinctly disclaims all connexion with us, whilst the Royal Society equally disclaims all control over us, except merely the nomination of the members of the committee.

13,868. As a matter of fact, all that the Royal Society does is to nominate the members of the Committee ?—That is all.

13,869. Having so done, it ceases to have any control whatever, does it not ?—Entirely.

13,870. What is the present organization of the Meteorological Office ?— The Committee consists of ten members (it originally consisted of eight), and they manage the office through me, and I have the assistance, in maritime meteorology, of Captain Henry Toynbee, a gentleman from the merchant navy.

13,871. What is the precise relation between the Office and the Government ?—That the Government gives a vote of 10,000*l.* every year, and that it calls

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

for no account of this money, excepting the account annually presented to Parliament. It has only recently begun to audit the accounts, as I shall state when I give my evidence upon the financial matters. The money is handed to me instantly the vote is passed, and until the year is out nothing more is asked.

13,872. Who audits the accounts?—The members of the Committee. There is no formal audit, because as the Government would not recognize any audit excepting its own, the Committee considered that it was not worth while paying an auditor if such audit would not be recognized, and, as a matter of fact, two of the members take the trouble of auditing the accounts every year. The form of audit is printed in the first appendix to our annual report, but I shall return to this subject more minutely hereafter.

13,873. What, in your opinion, are the chief advantages and disadvantages of such an arrangement as compared with those of the direct management of the Office by the Government?—The chief advantage is the perfect freedom from political management. The risk in being connected with the Government is that if a new President of the Board of Trade comes, he may reverse the action of the preceding one. The existence of a scientific supervision for the Office is exceedingly important; it acts as an intermediate party between the public and the Office. I may mention a decided disadvantage which results from the office not being connected with the Government, namely, the loss of *prestige*. The difficulty is that, if we are sending instruments by sea or by railroad, if we do not call them Government instruments we cannot get as much attention paid to them, and it is my opinion that we should get more co-operation from the merchant navy if we were an office of the Board of Trade. We should have more *prestige* as acting directly from the Government.

13,874. (*Professor Smith.*) Would you express any opinion as to the balance of those advantages and disadvantages which you have mentioned?—I think that the matter might be perfectly and simply arranged if the Government would allow us to call ourselves the Meteorological Department of the Board of Trade, managed by a Committee of the Royal Society, *i.e.*, if Professor Stokes' idea were allowed to be carried out, but the Government refused that permission in 1867, and stated that there was to be no connection. I think it is merely a fanciful idea on the part of the Government to protect themselves against claims for compensation. They made a careful statement that there were to be no claims for compensation on the part of the employés of the Committee, and that we were in no respects servants of the Crown.

13,875. How often do you say that the Committee meet?—They meet regularly every fortnight, and the last Monday of the month for drawing cheques, and in addition there are extra meetings if necessary. The reason they do not meet every week is that several of the members are members of the Geographical Society's council. Theoretically they meet every week if there is business, but they really meet every fortnight, and the last Monday, which comes to three or four meetings every month.

13,876. (*Chairman.*) Has the constitution of the Committee been modified since 1867?—Dr. Miller died and Mr. Spottiswoode has resigned, their places have been filled up, and in addition two members have been added to the Committee.

13,877. The change of constitution has only been personal, I believe?—Only personal.

13,878. How do they manage the office?—They meet weekly, or rather theoretically they meet weekly, practically they meet three or four times a month, excepting in the long vacation; in fact, they meet whenever they are wanted. Their action is recorded in the several volumes of minutes which are before the Commission.

13,879. What is your own position?—My own position is that of Director of the Office, and my duties were laid down after I had been there for two years, but since that they have been modified by the resignation of the Secretary to the Committee, and I have undertaken the secretary's duties as well.

13,880. Would you like to give any fuller definition of your own position than that?—I can give nothing excepting that I am the sole person who is responsible for everything under the office; that everything is managed through me, and that from the beginning all correspondence with the Government was conducted by me, and not by the Secretary to the Committee.

13,881. What is the position of the Marine Superintendent, Captain Toynbee, as regards yourself?—He has been appointed to render assistance to me in all matters connected with maritime meteorology, such as correspondence, the collection of observations from the sea, seeing captains, and superintending the publication of the marine work, for all which he is responsible to the Committee; but he is not summoned to the Committee meetings. He takes charge of the office in my absence.

13,882. Does he take his directions from you, or carry out his own work independently?—Practically he carries on his own work independently, but he takes his directions from the Committee through me officially.

13,883. What staff of clerks is employed?—There are 19; there are four senior clerks; there were three juniors; the number was increased yesterday to six. I mean that they were promoted from being temporary clerks. Then there are nine temporary clerks, an office keeper, and an engraver.

13,884. Are the occupations of the staff stated officially in any document?—In the annual report they are regularly stated.

13,885. Are they defined by the Committee to begin with, or do you define the duties of the staff yourself?—I arrange them, but report to the Committee on all matters of any importance whatever that are placed on the minutes of the Committee. I always refer to the Committee for all matters that seem to me to require it. There is some discretion allowed to me, but the minutes of the Committee are exceedingly full.

13,886. You have not mentioned whether you are accommodated in any public building?—I thought that was understood. We are certainly not. We were formerly; in the year 1869 we left.

13,887. (*Professor Smith.*) The rent that you pay is very considerable indeed?—I forget the precise sum, but it is about 500*l.* (N.B. 538*l.* 17*s.* 0*d.*)

13,888. (*Chairman.*) Your operations partly take place at sea and partly on land; to what extent is the sphere of those operations limited in either case?—At sea it is limited to British ships and British observers, and on land to stations within the British Islands; directly excluding the Colonies.

13,889. Was not the Office originally founded for maritime meteorology?—Yes, entirely.

13,890. To what extent is that branch of science still pursued?—We expend about 2,000*l.* a year on it. It is very hard (because the proportion of my salary cannot be put exactly down to it) to distribute the salaries for administration; but not quite one quarter of the amount which we get is expended in maritime meteorology.

13,891. What is the relation of the Office to the Royal Navy?—Formerly, under Admiral FitzRoy, the Royal Navy contributed a portion of the expenses of the office taken on the navy vote. The first year that the Committee took charge of the office the special vote for the Royal Navy also appeared on the Civil Service estimates, but it was afterwards cancelled. Now we supply all the meteorological instruments used in every ship in the navy, but we receive nothing in return. We simply keep a stock of meteorological instruments in the Meteorological Office, and in the dockyards, for which the storekeepers are responsible to the office, but that is all that we do. We supply the registers, and those registers may be sent to us if the officers choose to do it, but practically they are sent to the Admiralty, and we do not receive observations in return. It is simply a matter of course.

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

Every captain, according to the size of his ship, draws the quantity of instruments which he requires.

13,892. Do those returns officially go to the Admiralty?—Yes, the logs for the working of the ship, but the special meteorological registers, if kept, are sent to my office, but of these there are only about three or four a year.

13,893. Have you no opportunity of inspecting the ordinary meteorological registers of temperature, the barometer, and so forth, which are kept on board every ship?—None whatever, unless I obtain the logs from Somerset House by requisition. Practically we do not get much from the Royal Navy, but we do get a great deal from certain officers belonging to it.

13,894. You are in relation in some way with the Royal Navy by having the Hydrographer upon your Committee?—Yes; certainly the Hydrographer is *ex officio* a member of our Committee, and most meteorological questions referred to the Admiralty are sent to the Committee, as for instance, the question about the transit of Venus. The Astronomer Royal asked for meteorological instruments for the transit of Venus, but he was referred to the Meteorological Office, and the instruments were drawn from that office instead of being procured by a special vote for this service.

13,895. You put it in this way, that the relation between you and the Royal Navy is that the navy gets a great deal from you, but does not give anything to you?—I do not mean to imply that. We get our grant on the condition of supplying the navy to the extent of 500*l*. or 600*l*.

13,896. What is the relation of the Office to the merchant service?—We lend instruments to any captain of whose competency we are satisfied, and receive his observations in return.

13,897. Does any merchant captain, who thinks fit to apply, get the instruments from you?—If he shows that he is able to observe.

13,898. Who is the judge upon that matter?—Captain Toynbee entirely. At the sea ports if a man cannot see Captain Toynbee there is a certain form filled up, and questions are asked about any new man before the instruments are supplied.

13,899. Do you get any large number of returns from the Merchant Service?—Not very many. The number of ships supplied on an average of seven years is only 75 per annum. The difficulty has been this; we thought at one time that we could get co-operation by speaking to the large steamboat companies, like the Cunard Company, but we found that the instant any *order* was issued to a captain to observe, he ceased to observe. We have simply to make personal friends of the captains. I must say that the quality of the observations is very high indeed, and certainly the opinion of a good many men of experience, like Professor Buys Ballot of Utrecht, is that too much is asked for in maritime meteorology, and that observers are afraid of undertaking the duty.

13,900. Agents at certain ports are mentioned in the reports. What are their duties and remunerations?—They are stated at page 78 of the Minutes of Proceedings for 1873. There are men in the ports of Liverpool and Aberdeen, and one or two other ports, and they receive a small fee, and that fee is increased if the observations forwarded are good.

13,901. You pay upon results to a certain extent?—Yes. What I should wish particularly to observe, as there has been a misunderstanding about the agency, is that the amount of money is really not very much; perhaps 20 or 30 ships are supplied in other ports, and that is divided between three or four agents; not more than 10*l*. a year in each case. It is not creating highly salaried officers at the sea ports, but it is the only way that we can get observations. For instance, some of the most important observations that we get are from the whalers and are got through the agent at Aberdeen.

13,902. Are observers paid or remunerated in any way?—Not in the least, unless that they have the free use of valuable instruments. If they send first-class observations we present them as a compliment with a book, worth 2*l*., of Admiralty charts. There is no payment of any sort or kind, but then they receive publications which would interest them.

13,903. Is there any idea of a modification of the system in respect of the supply of ships?—We are thinking of asking ships to send us their own logs, instead of taking our form of register, and possibly we might get more information if we borrowed the ship's log, than if we demanded always our form of register. The question is now under deliberation.

13,904. Do you consider it important that the Office should be in connexion with the Board of Trade?—Decidedly, for the reason which I mentioned before, that almost every captain, unless he is a man whom we know most intimately, writes to us saying that he will observe for the Board of Trade. They do not know much about the Royal Society, and unless we were able to say that we had an indirect connection with the Board of Trade, I think that we should not get even what co-operation we do.

13,905. When was the idea of a comprehensive scheme for the land meteorology of the United Kingdom first thrown out by the Government?—I must now refer to the original letter of the Royal Society in 1854. I am not in possession of the letter of the Government to which this was an answer, but the answer of the Royal Society, which appears at page 8 of the Appendix of the Report of the Committee in 1866, says, "Their Lordships further state, that as it "may possibly happen that observations on land, upon "an extended scale, may hereafter be made and dis"cussed in the same office, it is desirable that the "reply of the Royal Society should keep in view and "provide for such a contingency." Those were Mr. Cardwell's words at that time.

13,906. That is the reply to the letter from the Government?—Yes, it is the letter from the Royal Society to the Government, which contained the original orders under which Admiral FitzRoy organized the office in the year 1854. It is the first official statement on the part of the Royal Society of what was to be required from the office.

13,907. What are the broad features of the present system?—The system is that we have certain observatories with continuous observations, recorded automatically, distributed over the country, and those records are examined at a central observatory, and then sent to the Meteorological Office for discussion.

13,908. When was this system devised and by whom?—It was devised, I believe, by the then President of the Royal Society, Sir Edward Sabine, and was contemplated and recognised as having been proposed, when the Report of the Commission of Enquiry was presented, for they refer to it. The whole of the statements of these preliminary negociations are to be found in that paper of Sir Edward Sabine's in the 15th volume of the Proceedings of the Royal Society.

13,909. How many observatories are there?—Seven.

13,910. What is the central observatory?—The Kew Observatory.

13,911. What are the names of the stations?—Kew, Falmouth, Stonyhurst, Glasgow, Aberdeen, Valencia, and Armagh. The idea that was contemplated was six stations in the first instance, as mentioned in another letter from the Royal Society, dated 15th of June 1865, and the additional station to those originally contemplated by the Royal Society has been Valencia.

13,912. Has any idea ever been entertained of utilizing Greenwich as the central observatory?—There has been a good deal of correspondence between the Astronomer Royal and the Committee with reference to this subject of late years. As soon as the Astronomer Royal became President of the Royal Society, a certain correspondence passed, which was contained on the Minutes, and the result was that things went on as they did before. There was no change in the management. The references to the correspondence are all on the Minutes, and if the

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

Commission would wish me, I could quote the particular statements.

13,913. Perhaps you could tell the Commission briefly what was the general tenor of the correspondence?—The first letter was a letter about the expense of our publications. Perhaps, I think, it might be better if I explained this. The first notice was in the Minutes of 1871, page 61: "Mr. Scott stated he "had received a letter from the Astronomer Royal, as "President of the Royal Society, asking for some "information respecting Kew, which he had sup"plied unofficially." Then comes, in the year 1872, this report: Mr. Scott reported that this letter "had "contained an inquiry relative to the cost of the "Quarterly Weather Report, to which he replied that "he was not able to give the precise cost of the "publication of the curves in the Quarterly Weather "Report, as the expense of that work was borne by "the Stationery Office." I then reported that the Controller of the Stationery Office had informed me of the amount of expense in question. The Astronomer Royal wrote again (January 13th, 1872) to ask for the information. That is at page 1 of the Minutes of 1872, and the reply then, which is exceedingly important, is this: "The Meteorological Committee "hope that the Astronomer Royal will not attri"bute to them any discourtesy if they ask him "to be so good as to inform them whether he re"quests to have the information he desires in his "private capacity, or as President of the Royal "Society, because a question of grave import may "arise if there should exist any misunderstanding as "to the constitution of the Committee and its relation "to the Royal Society. On this point they take "leave to refer the Astronomer Royal to the third "paragraph on page 3 of Parliamentary Paper "No. 246, session 1869, enclosed herewith, which "runs as follows: 'It may seem scarcely necessary "'to state that the Royal Society, further than "'having, at the request of the Government, nomi"'nated the superintending Committee (of the Me"'teorological Office), and retained the right of filling "'up vacancies, should such occur, is in no way "'connected with the Meteorological Office.' The "Committee, with the sanction of the Board of Trade, "would have no objection to furnishing the Astro"nomer Royal in his private capacity with the facts "relative to the cost of the plates in the Quarterly "Weather Report, which have been recently communi"cated to them by the Controller of the Stationery "Office." The answer of the Astronomer Royal is to be found at page 3 of the same Minutes, and it is in these terms: "I have to acknowledge your letter of "the 16th, conveying the request of the Meteorologi"cal Committee to be informed whether the com"munication of the amount of expense incurred for "meteorological plates was asked by me in my "private capacity, or as President of the Royal So"ciety. I admit the propriety of this inquiry, and "reply as follows: I disclaim any authority in con"nexion with the Royal Society to control the daily "proceedings of the Meteorological Committee. (For "precise understanding of the relation between the "two bodies I am indebted to your courtesy in send"ing me a copy of the letter M. 3,611.) Neverthe"less, the close connexion implied by the original "formation of the Committee, and the continued ap"pointment of members in case of vacancy, seems to "make it matter of duty in the officer representing "the Royal Society to be acquainted with the gene"ral proceedings of the Committee. These, whether "in action or in expense, are subjects not of private, "but of public interest, and are so recognised by the "Committee in the publication both of its active mea"sures and of its immediate expenses; and it would "seem, therefore, that the communication of amount "of another branch of expense, hitherto not known to "the Committee, might now be expected by the Royal "Society. Probably if I had not become President I "might not have made this inquiry, and, so far, the "inquiry is connected with my presidential character, "I should, however, be glad, on other grounds, to be "possessed of the knowledge to which I refer. I "might, perhaps, consider the propriety of thus re"cording the observations of this observatory, which "would depend (among other elements) on the ex"pense. I have only to add that I am fully sensible "of the respect which is due to a committee of "gentlemen who have gratuitously given so much "time and labour to an object whose importance with "them I entirely appreciate." Then I was instructed to furnish the information, and the letter, which was prepared, as all important letters are, by me, and submitted to the Committee before being sent, was as follows: "I am instructed by the Committee to inform "you, in reply to your letter of the 18th, that the "Controller of the Stationery Office has intimated to "them, in his letter of the 11th instant, that the cost "of transferring and lithographing the plates for the "seven observatories in the report, is 88*l.* 3*s.* 1*d.* per "quarter, or 352*l.* 12*s.* 4*d.* per annum. I am to draw "your attention to the fact that this estimate is framed "on the cost of the first two quarters for 1870, being "the latest for which the accounts have been re"ceived," and so on. I need not read the remainder of the letter. Then comes a letter which the Council of the Royal Society suggested to the Astronomer Royal to submit to the Committee. The Astronomer Royal says, at page 6 of the Minutes for 1872: "At the meeting of the Council of the Royal So"ciety on the 18th instant, I submitted for the "consideration of the council the question of charg"ing the Royal Observatory of Greenwich with "those meteorological observations which are at pre"sent carried on at Kew Observatory for the purposes "of the Meteorological Committee, and for which at "present a subvention of 250*l.* annually is paid by "the Government. At the suggestion of the officers "of the society, my paper addressed to the council "had been printed, and I now enclose a copy, "which I request you to lay before the Meteorologi"cal Committee. It will be perceived that my "idea was (and I still judge it most probable), that "the selection of observations had been made by the "Royal Society, and therefore that all remarks on "them ought to be addressed to that society. Some "doubts, however, having been expressed on that "subject, I most willingly undertook to communicate "my proposal to the Meteorological Committee also, "a course which, under any circumstances, I should "have considered at some time indispensable. Should "the Royal Observatory be charged, as I propose, "with the observations in question, the Meteoro"logical Committee may be assured that the most "careful attention will be given to their require"ments." This enclosure was headed: "Confidential, "for the use of the Members of the Council of the "Royal Society only." "The President submits the "following remarks to the Council. The institution "and discussion of extensive meteorological observa"tions has been undertaken by Her Majesty's Govern"ment, mainly at the instance of the President and "Council of the Royal Society. The Meteorological "Committee is virtually a committee of the Council, "and the annual accounts of expenditure are pub"lished by that Committee. These circumstances "appear to leave it perfectly within the competence "of the President to remark on the nature of some "parts of the outlay incurred in prosecuting the "objects of the Meteorological Committee. Among "the expenses is an annual grant of 250*l.* to the Kew "Observatory, for meteorological observations made "there as at one of the stations of the Meteorological "Committee. Now, in estimating the propriety of "this grant, it is to be remarked that within a few "miles of Kew, is the Meteorological Department of "the Royal Observatory of Greenwich, instituted by "Her Majesty's Government several years before the "establishment of that of Kew, maintained by the "Government at considerable expense, more com"plete in its equipment than the Kew Observatory, "at least equal to it in the excellence of its instru-

R. H. Scott,
Esq., M.A.,
F.R.S.

22 April 1874.

ments, and under the most careful daily superintendence, and perfectly able to furnish to the Meteorological Committee, at insignificant expense, all that is now furnished with an annual expense of 250*l.* to the Government. It cannot, I think, be considered right still to load the Goverment with this unnecessary expense. And I propose to the Council that steps be immediately taken for the transference to the Royal Observatory of the observations in conjunction with the Meteorological Committee now taken at Kew. As Superintendent of the Royal Observatory, I engage that everything practicable shall be done to render its observations available to the Meteorological Committee. My remarks do not in any degree apply to other expenses incurred at Kew for the Meteorological Committee, to which, on general grounds, I see no objection."

13,914. I apprehend that document was simply sent on, on the recommendation of the Council, as the personal act of the Astronomer Royal?—Entirely.

13,915. That document was not in any way adopted by the Council?—I have not examined the Council minutes, but I have been informed that it was negatived by the Council. The circumstance was simply that the Astronomer Royal said, I most willingly undertake to lay before the Council of the Royal Society my proposal. There was no responsibility of the Council connected with it. My reply then is found at page 9: "In reply to your letter of 22nd ultimo I am directed to state, in the first place, with reference to the second and third paragraphs in that letter, that the Meteorological Committee are not *officially* informed of what may have taken place at the Council of the Royal Society on 18th ultimo. They consider that the relations between the Society and themselves are fully and explicitly defined in the correspondence contained in Parliamentary Paper No. 240, 1867, and in the Report of a Committee appointed to consider certain questions relating to the Meteorological Department of the Board of Trade, &c., presented to Parliament in 1866, where the original letter from the President and Council of the Royal Society, dated June 15th, 1865, has been reprinted (App. p. 111). In this report you will find the original recommendation of the Kew Observatory, as the central observatory of the land meteorology of the British Islands, and a summary of the relative duties and responsibilities of the central observatory, and of the five" (in a note, "subsequently increased to six,") "affiliated observatories to be established in different parts of the British islands, and to be supplied with self-recording instruments verified and compared with the Kew standards. The scheme thus originally suggested, and afterwards examined and approved by a committee appointed at the request of the Board of Trade, was adopted by Her Majesty's Government, and is carried out by the Meteorological Committee. It is not, in the opinion of the Committee, their duty to report to the Council of the Royal Society any portion of their proceedings. As a matter of courtesy, however, a copy of their Minutes, which are printed but not published" (those copies which are before the Commission), "is forwarded annually to the Society. A full report is regularly sent to the Board of Trade, which is subsequently presented to Parliament, by which body the requisite funds for carrying on the whole of their establishment are voted. The Committee would express their well-considered opinion that it would not be possible for them to retain Kew as an efficient establishment for the control of their other observatories, and for the verification of meteorological instruments, unless the various operations of a continuously-recording meteorological observatory were carried on there. It is an essential part of any system such as theirs is that the normal observatory should be controlled by an independent unpaid governing body, and should not be connected with an official paid department of the Government, over which they have no power. In conclusion, I am directed to add, that the Committee do not consider it their province to enter into any discussion with the head of any other observatory of the suggestion contained in paragraph 3 of your enclosure, wherein you proposed 'to the Council of the Royal Society that steps be immediately taken for the transference to the Royal Observatory of the observations in conjunction with the Meteorological Committee now taken at Kew, &c.,' but will be ready to advise the Board of Trade, under which department they act, if they should be consulted in the matter." The final letter of the Astronomer Royal is this, on the 8th of February 1872:—"Dear sir, I have not yet succeeded in procuring the two papers (of 1866 and 1867) to which you refer in your letter of February 2nd, and would ask if you could lend them for a day or two. On other points I would only assure you that I make no claim of interference with the proceedings of the Meteorological Department, and that I have no feeling but one of respect towards the Meteorological Committee. But the question of original organization, which naturally was not determined by them, appears to be open to me. The opinion which you cite, on the necessity of retaining Kew as an active observatory, is worthy of the most respectful attention, however much it may differ from my own. Will there be any objection to my reading your letter at the Council of the Royal Society on February 15th," and I was instructed to reply that we had no objection whatever. Since that there has been no further communication.

13,916. Are there any extra stations provided with a partial self-recording outfit?—There are three supported by the Committee, and three co-operating. With regard to those supported by the Committee, there is one at Sandwick Manse in the Orkneys, with an anemometer managed by the Revd. C. Clouston, a very old observer. There is an anemometer at Holyhead. There is an anemometer at Yarmouth, and, in addition, the Duke of Northumberland furnishes us with records from Alnwick Castle. The Marquis of Londonderry has allowed us to put up at Seaham an anemometer lent us by another gentleman, Mr. Crossley of Halifax, who also sends us observations from his own station. Those are the stations from which we get continuous records.

13,917. How many telegraphic reporting stations are there in the United Kingdom?—There are 29 in the United Kingdom for the morning reports and seven for the afternoon ones.

13,918. What is the relation of the Observers to the Office?—They are paid usually 5*s.* a week, and in a few places 1*s.* 6*d.* a week extra for furnishing sea reports, and they all hold their offices directly under the Meteorological Office, which is different from all other meteorological organisations, excepting that of the United States. We have almost entirely got free from the Post Office, because it is necessary that we should have the power of dismissal from the duties of reporter, and that the men should not be changed from station to station without our being consulted.

13,919. Are these stations inspected regularly?—Since I have been director they have always been inspected till within the last two years, when I found that one or two stations (and I think there were four last year) might be omitted, that it was unnecessary to visit every year. The stations have gone on for six years perfectly regularly. The telegraphic reports showed that they were working well, and that it was possible to omit them, but this duty of inspection, owing to the want of funds, had only in a very few instances been undertaken during Admiral FitzRoy's time.

13,920. You say that the pay of those observers is at the rate of 5*s.* or 6*s.* a week, and you retain the power of dismissing them. What kind of persons are those observers?—Their other duties are stated in the last Report. If I take the Report for 1872, a

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

list of observers is given there, at page 65, of Appendix VII. The first observer is a schoolmaster, the master of a navigation school at Sumburgh Head; the next is the gardener of a gentleman of extensive property at Stornoway; the third is a ship carpenter who lives at Thurso, and has been a good deal at sea; the fourth is a watchmaker, and so on. Some of them are telegraph clerks, and in six cases we have men of a very high stamp. We have the observatories at Oxford and Cambridge and the services of the assistants there. We have Dr. Merrifield, a fellow of the Astronomical Society at Plymouth, and we have Mr. Lowe at Nottingham, and Mr. Hartnup, junr., at Liverpool.

13,921. Do these persons send their telegrams as anybody else would send them?—Yes, precisely, excepting that they have passes, and whenever we send a telegram it has the right of precedence over all, excepting Government messages, when it has got the Meteorological pass on it.

13,922. Does the Office receive co-operation from volunteer observers, and to what extent?—It does to a very considerable extent, and the extent is increasing. A list of the volunteer observers is to be found in the Report for 1872, at page 22. A considerable number of gentlemen furnish us with observations of various degrees of completeness, and they receive printed results in return. This is very important, because it has frequently been stated, and is still uncontradicted officially, that we had no person in connexion with us who was not paid.

13,923. In what ratio does the number of volunteer observers stand to the paid observers?—We cannot, in a statement of that kind, well give the details, because we have not commenced yet to furnish returns from the volunteer observers. The number of names that are down at present is 40 volunteer observers, but they do not all send full returns; 40 gentlemen supply information freely to us of various kinds.

13,924. Have the public displayed a readiness to co-operate with the Office?—The number of volunteer observers is constantly increasing. I get a letter like this from a man, saying "If you will only call me your observer I will promise to send you anything you want." We decline any control over volunteer observers, because we have no right to control men whom we do not pay.

13,925. Has the idea of mutual action between the Office and the Meteorological Society been ever mooted?—In this matter I would wish to hand in to the Commission the Minutes of this year (*delivering in the same*). It is a very simple matter, and you will find it at page 18. Recently the Meteorological Society in London has proposed to co-operate with us, and we have said that we should be ready, but that we had no funds at present by means of which we could give them any remuneration for the increased work which would be thrown upon the Society.*

13,926. The proposition came, did it not, from the Meteorological Society?—Yes, but then I may say that it is in harmonious action, because I am the foreign secretary of the Meteorological Society, but it did certainly originate with the Meteorological Society.

13,927. (*Professor Smith.*) What was the nature of the concerted action that was proposed between the Office and the Meteorological Society?—Nothing has been laid down completely, because of the letter from the Meteorological Society, simply saying that they wished to co-operate, but the general idea is, that if we had money by means of which a small grant could be allowed to them, we might get all the eye observations, as distinguished from the self-recording ones, through them, and that we might transfer the volunteer observers to the Meteorological Society, and recognise it as a collecting body. That is a possible basis for negociations, but it has not come so far as that, simply because the Meteorological Committee have no money as yet to offer.

13,928. (*Chairman.*) Do you think that the motives which lead the public to volunteer observations to the office would operate so strongly in leading them to volunteer to give assistance to the Meteorological Society?—A great many of these gentlemen are Fellows of the Meteorological Society, and I know one or two who would be reluctant to give observations to the Office, for fear that it would damage the Society. I think there would be a possibility of starting harmonious action between the Society and the office.

13,929. You have had some correspondence, have you not, with the Scottish Meteorological Society?—There has been constant correspondence almost.

13,930. What has been the tenor of that correspondence?—The main tenor has been a wish to obtain a grant of money to aid the society.

13,931. Did that body from the first raise objections to the establishment of an organization embracing Scotland as well as England and Ireland?—Apparently not, for with regard to the Report of the Committee of Inquiry, which is contained in the Parliamentary paper, number 206, 1867, they approved entirely of the Report excepting the question of whether or not the direction of the wind should be indicated in storms.

13,932. Will you mention what their objections were?—It is a very long correspondence. The first letter was my letter of January the 19th, 1870, asking them to put me into communication with their observers at certain named stations. Their reply was that it would give them sincere pleasure to be of any service to the Committee, but their observers "give their "valuable services, not only gratuitously but as a "sort of favour to the Society," and therefore they say "the Council do not feel themselves in a position to "ask their observers to undertake the labour of "filling up other than the Society's schedules, and "the more so as having been asked by the Registrar-"General for an additional schedule, the Council "were assured that in some instances this request "would be refused. The Council, therefore, after "due consideration of the matter, regret that they "cannot see their way to sanction any direct com-"munication between your Committee and the Society's "observers; but on the other hand the Council being "desirous to give what assistance they can to the "Meteorological Office, have instructed Mr. Buchan "to supply whatever information is contained in the "existing schedules, and to use every endeavour to "procure further information from such of the ob-"servers as may be disposed to afford it." In reply I sent a number of forms at once. The next communication is in the Minutes of 1870, at page 35, an extract from the Minutes.—"Mr. Scott's letter "having been read, the Council, before instructing "Mr. Buchan to proceed with the filling in of the "schedules which had been forwarded from the Me-"teorological Office, resolve, with the view of pre-"venting any misunderstanding between the Meteo "rological Committee and the Council, to propose the "following as the basis of agreement: 1. That the "Meteorological Committee forward the schedules to "be filled up to the Society's office, stating the date "from which the extracts of observations are to be "made; 2. That the extracts of observations be "made or verified by the Society's secretary under "direction of the Council, and be then forwarded "by him to London; 3. That in the event of the "Meteorological Committee requiring any explana-"tions they shall apply to the Council for such in-"formation; 4. That no direct communication shall "take place between the Meteorological Committee "and the Society's observers." The reply to that was that the Committee accepted the first three terms—that the schedules were to be furnished, that extracts were to be made by the secretary, and that explanations were to be procured through the secretary. The Committee then stated to me that they would conduct all their communications with the observers through the Council with the excep-

---

[* See Supplementary Evidence in Appendix III., p. 3.]

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

tion of four gentlemen named, with whom we were at that time in Communication, but the agreement was not to preclude the establishment of other stations in Scotland by the Committee, independently of the Scottish Society. The answer to this was the answer upon which the whole thing has turned. At the same time the Scottish Society had, *pari passu*, carried on negociations with the Government asking for a special grant, and the reply of the Board of Trade to the Scottish Society was this, at page 37 of the Minutes:—"That the Board have carefully con-" sidered the memorial and the statement enclosed in " your letter, and that they are unable to find any " grounds on which they can entertain and submit to " the Treasury any proposition for a separate grant of " public money to the Scottish Meteorological Society. " The Board of Trade will, however, be pleased to " hear at any time that an arrangement has been " effected between the Meteorological Committee of " the Royal Society and the Scottish Meteorological " Society whereby the Scottish Society will co-" operate in carrying forward the objects sought to " be attained by the Meteorological Committee. If " and when such an arrangement is made, the Board " of Trade are satisfied that the Meteorological Com-" mittee will pay to the Scottish Society a proper sum " in consideration of the services rendered." The Minute which I am now going to read refers to both those negociations, and it is to be found at page 51:—" The meeting having had laid before them the reso-" lution of the Meteorological Committee of date " 4th April, resolved to agree to the same, except " with reference to the last paragraph, referring to " the establishment of new stations in Scotland, with " regard to which the Council beg to express a hope " that the Committee would do them the favour to " communicate with them before establishing such " stations. The meeting had at the same time before " them the answer by the Board of Trade to the " memorial of the Council asking for a separate grant " of public money, in which answer their lordships " state that, whilst unable to move the Treasury to " give a special grant, their lordships will be pleased " to learn that an arrangement had been effected " between the Meteorological Committee and the " Scottish Society whereby the latter will co-operate " in carrying forward the objects sought to be at-" tained by the Committee. The Council resolved to " agree to this proposal, and, in accordance therewith, " to intimate their desire to co-operate with the " Committee, leaving to the Board of Trade to fix the " amount of the sum to be paid in consideration of the " services rendered. In any such arrangement it " will of course be understood that the independence " of the society in the management of its affairs shall " be in no wise affected." The difficulty in that matter was in my opinion that the society meant a grant of 300*l.*, and we meant a grant of 20*l.* or 30*l.* The amount of co-operation that we were prepared to pay for was certainly not 50*l.* per year, and they gave me to understand that they would take nothing less than 300*l.* Then comes a letter of the 9th of May 1870, which has been suppressed in certain correspondence printed by the Scottish Society. A private letter was written to me by Dr. Keith Johnston in these terms:—" On the 27th ultimo I transmitted " to you extract from Minutes of Council of the " Meteorological Society, asking your Committee to " suggest terms of an arrangement between you " and us. Some of our friends in Parliament have " written to say that in the view of the impending " discussions in the House of Commons on the subject " of the annual grant of 10,000*l.*, they are very " anxious to learn whether a satisfactory agreement " has been effected between your Committee and us. " They say that such an agreement, if it could be " referred to in the course of the discussion, would " strengthen their hands in upholding the grant " against sundry enemies to its continuance. We " shall be glad to receive an immediate reply from " your Committee." That letter has been suppressed in any account of the correspondence which I have seen as emanating from the Scottish Society. My answer to that was:—"Dear Sir,—The excerpt " from your Minutes was laid before the Committee" (I did this without showing it to the Committee, but I showed it afterwards), "but they did not instruct " me to send any further reply. It does not contain " any request that this Committee should 'suggest " 'terms of an arrangement.' It simply asks us to " let you know when we are about establishing new " stations in Scotland, which we shall of course " do. The co-operation which we *have* asked " for is, as regards the observations of wind and " weather, out of my application, for which, in " January last, the correspondence has arisen. The " Committee do not meet till Monday next. Could " you kindly let me know whether there could have " been any mistake in copying the words of the " excerpt sent to me? It most certainly contains no " request of the nature indicated in your letter." The answer to that was: "Dear sir,—I regret that " you did not clearly understand the meaning of the " communication I sent you from our Council meeting " of the 26th ultimo. It may not have been very " explicitly stated in my letter, as the papers were " not at hand at the time. But our meaning was " simply to ask if your Committee are prepared to re-" commend to the Board of Trade that we should " have the grant of such a sum of money as will enable " us to engage a clerk and other assistants, in order " that we may co-operate with you in the manner in-" dicated by the board. It will, therefore, be a favour " if you will bring the matter before your Committee " at your meeting on Monday next, and communicate " to me the result of their deliberations by that day's " post, in order to guide our society in their future " proceedings." I was instructed to reply as follows: " In reply to your note of the 13th instant, I am " directed to acquaint you that the Meteorological " Committee are not prepared to recommend to the " Board of Trade that your society should receive a " grant of money to enable them to engage a clerk " and other assistance. The co-operation the Me-" teorological Committee proposed is explained in my " letter of January the 17th, and in the memorandum " (No. 17) already forwarded, and of which I now " inclose another copy. You will observe by the first " paragraph, second page, that the form is to be filled " up only whenever a storm, or very sudden change " of weather, is noticed; and also occasionally when " specially requested by letter. The expense in-" curred from time to time in obtaining and forward-" ing this information, the Meteorological Committee " are prepared to defray." This arrangement has never been acted on. The sole information ever received from Scotland has been at one time in my absence, when Captain Toynbee was working up a storm in the Atlantic in February 1870, and when he wrote for, and received, certain information from Scotland, but for a space of three years no information whatever was received. Then a further correspondence arose about the establishment of the station at Stornoway, because I considered that the whole of those arrangements had lapsed owing to the non-fulfilment of their part of the bargain. They consider that the bargain is binding upon us, and that sending the observations in one instance, whereas they had undertaken to send it in *every* case of a storm, was a fulfilment of their part of the bargain, and a further correspondence has been carried on which is exceedingly long, but it has all been an argument as to the meaning of that last excerpt from the Minutes. The last words of a Minute of their Council of date June 14th 1870, stated that they had "agreed that the failure of their negociations with the Royal Society Committee should be reported to the Board of Trade," and we considered that that referred to the failure of the whole of their negociations, while they maintained that it referred only to the failure of a part. There is a matter which I should very much like to submit to the Commission. I have here a memorandum which I submitted some years ago to

R. H. Scott,
Esq., M.A.,
F.R.S.

22 April 1874.

Sir John Lubbock, but the state of the case has not changed since. It shows the amount of our expenditure on outfit and arrangements for the three kingdoms, showing what it was in the years 1869–70, and it is not materially changed of late. If the Committee wish it, I could make it up for the last year, but I think that the year named would do. The expenses for the United Kingdom are as follows:

STATEMENT showing the NUMBER of SELF-RECORDING OBSERVATORIES, TELEGRAPHIC REPORTING STATIONS, and STORM SIGNAL STATIONS, established by the METEOROLOGICAL COMMITTEE; and the NUMBER of PLACES supplied with FISHERY BAROMETERS, to the end of the Year 1869.

Stations, &c.	England.	Ireland.	Scotland.
Self-recording Observatories -	3	2	2
Telegraphic Reporting Stations -	9	4	6
Drum Signal Stations - -	70	10	26
Fishery Barometers - -	54	18	40
Do. do. supplied during 1869.	3	1	3*

* One of these repaired only.

STATEMENT showing approximately the AMOUNTS paid for METEOROLOGICAL ESTABLISHMENTS and SERVICES in SCOTLAND compared with other portions of the UNITED KINGDOM during the Financial Year 1869–70.

Services.	England.			Ireland.			Scotland.		
	£	s.	6.	£	s.	d.	£	s.	d.
*Establishment of Observatories.	959	4	6	822	16	10	782	17	10
Expenses at Observatories.	1,398	10	3	811	14	2	586	14	6
Observatory computations.	161	14	3	107	16	0	107	16	0
Telegraphy—reports to office.	†458	17	8	458	17	8	458	17	8
Telegraphy—warnings issued.	157	17	0	52	12	4	105	4	8
Telegraphy — computations.	168	18	9	75	1	8	112	12	6
Fishery barometers supplied.	12	15	0	4	5	0	9	8	0
Totals - -	2,358	12	11	1,510	6	10	1,380	13	4

* The Establishment was *prior* to the year 1869; all other charges were actually paid within that year.

† The cost of telegrams is roughly estimated to be about equal for the three kingdoms. In 1869 an Irish message cost more than two English, and a Scotch message cost about one-and a half English. These figures have therefore been altered since 1870 but not materially.

There is another question which I ought to refer to. Formerly the Society did work much more harmoniously with the office, in fact the office assisted it, as Admiral FitzRoy had assisted the Society materially in its establishment. There have recently been very unpleasant negociations carried on at various times. Up to the time that the Committee was appointed, whenever the Society wished to establish a foreign station, say in Jerusalem, in the Faroe Islands, or in Iceland, they came and got their instruments from the Meteorological Department, but the instant the Royal Society Committee came into operation they, not being allowed to lend instruments for use abroad, this was at once put an end to, so that the Society has received practically nothing since the Committee has been established, excepting the instruments which had been previously lent for use at foreign stations as above described, which are presented to the Society, the total value being about 100*l.*

13,933. Do the coastguard and light-house officials co-operate with the office?—We could obtain, and did at one time obtain, co-operation from the coastguard, and I am at present engaged in some negociations which are going on exceedingly harmoniously with the English and Irish Light-house Boards about sea temperatures. The coastguard officials presented us with reports on wind and weather to test our storm warnings in the years 1868 and 1869, and the fact has been, that we found that no two coastguard watchmen agreed in their reports, owing to the circumstances that these men were in coves and in landing places differently sheltered from the winds, whereas the ships were outside the headlands and felt winds which did not reach the observers on shore, so that the observations did not agree with each other, and we have actually had to cease using them. I may say that the men were not paid for the work. We got it because we had the power in connection with the Board of Trade to obtain information from the coastguard, but of course we did not dare to ask for too much. We could at once move the Controller of the coastguard, but the work would be ordered, and we should not get anything worth having.*

13,934. Has there been any reason for the non-establishment of a series of stations of the second order?—Perhaps as the title "second order" is perfectly new, and it has been only defined last year in Vienna, I may say what I mean by that: I mean stations which take less than six observations a day; in fact, ordinary stations, which still are good stations, but they do not take as many observations as could be obtained at a first-class observatory. It would appear to be interfering with the Registrar General's work, and Mr. Glaisher's organisation, if we were to commence to publish. I am prepared to publish something like 20 stations, but I am waiting till I get a larger number to begin to publish. At present our land publication simply consists of the records of some of our self-recorded observations, seven in number, and of certain publications connected with the telegraphic stations.

13,935. Has the chief reason for the non-establishment of a series of stations of the second order been a desire not to interfere with some which already exist?—Certainly. I mean that we do not wish to bring ourselves into direct collision unless there was such an amount of public benefit likely to be produced as would justify it. I do not think that 20 stations over the British islands would justify it. It would be considered that it was merely a beginning, a getting in of the thin end of the wedge. I have not been urgent in this matter. We have always said that so long as the Registrar General publishes his returns, the Committee have not thought it necessary to issue information of a similar nature, and they have not at present made up their minds to publish.

13,936. Has any correspondence passed between the Government and the Committee as to the Quarterly Returns issued by the General Registry Office?—A very considerable amount of correspondence has taken place just lately.

13,937. What is the tenor of that correspondence?—Nothing has ever been mentioned with relation to the preparation of these returns on the estimates until this year. The Treasury thought that Sir George Airy did it (I can show that by a letter of July 9th, 1858, signed by Sir C. Trevelyan), whilst it was a private arrangement with Mr. Glaisher. When inquiry was made into this (I do not know how that originated), they found out that there was a small allowance of 150*l.* a year, and the Treasury asked whether we could not undertake to do the work. The correspondence went on, and we finally stated that we were perfectly ready to undertake the work without making a charge of 150*l.* a year. There was a good deal of extra correspondence which passed, with enclosures and various things, which have not been printed in the Minutes, but the whole of the corres-

---

[* See Supplementary Evidence in Appendix III., p. 5.]

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

pondence ended by our saying that we were perfectly ready to furnish the information to the Treasury without any increase of payment. These two charts will show, if you glance over them, what we could do (*handing the same to the Chairman*). The blue marks are the stations which we could substitute, and the red marks are the stations which the Registrar General published in his last report. I append a list according to the counties. See Appendix A.

13,938. (*Dr. Sharpey.*) Did not Mr. Glaisher represent that he had sources of information which were not open to the Meteorological Committee?—Yes, and we replied to that; but we have not yet asked for special observations from any of his stations, and we do not think that any important ones have been left out in our list. But without counting any of these stations, excepting those which are actually in our pay for telegraphic reports, we could substitute a more complete list.

13,939. (*Chairman.*) Is the Meteorological Office willing to furnish returns for the Registrar General's Tables?—Yes, and to submit a satisfactory list of the stations.*

13,940. What is the nature of the British rain-fall organisation?—Entirely private. Mr. Symons organised it many years ago. I am not quite certain in what year, but I think it was about 1860. He has since 1864 regularly received a grant from the British Association, and occasional grants from the Government Grant Committee for investigations connected therewith.

13,941. Do you see any practical difficulty in the way of granting the money required from the Meteorological Office?—Certainly. Mr. Symons would not accept it unless as a donation. The Meteorological Office as at present constituted could not grant money without exercising a control. I have recently seen Mr. Symons as regards this very subject. I said I am going to speak about your organization, and I should like to know whether you will support what I say. He said, "I must have absolute and entire control," or at all events he gave me to understand that.

13,942. Has not the British Association discontinued its subsidy, so that there would be no chance of Mr. Symons getting it?—The subsidy of the British Association is of comparatively minor importance to him. The expense exceeds the subsidy, I am told, by nearly 1,000*l.* a year. I would rather that these statements should come from Mr. Symons directly, but I know as a matter of fact that the gentlemen who furnish him with observations also furnish him with money. He is apparently seriously out of pocket in the proceeding, and he has appealed to the country to subscribe, but the country has not subscribed, I suppose, saying that we are there, and that we ought to do the work. Last year a committee of his friends was called together to ask him how they could help him out of the difficulty, and he said that he would accept of no help which did not leave him absolutely free even from the Meteorological Society, which is a small society, and connexion with which he declined. If any balance sheet is published by him and I can furnish it, I will add it to my evidence.

13,943. Supposing that the present British rainfall organisation ceased to exist, could the Meteorological Office take it up?—It would not take it up on the same scale. I do not think that 1,600 stations for the United Kingdom are wanted.

13,944. Do you think that the facts could be determined by the office in a better or less expensive way?—Not in a better way. Mr. Buchan's investigations in Scotland, where the surface is very irregular, have clearly shown that the rainfall in one catchment basin bears no proportion to the rainfall in the next catchment basin, and that there is no proportion as to height; that you would want gauges in every parish; it is impossible to say to what extent. My private opinion is that there are more stations than are requisite for the *meteorology* of the country, but not for the *rainfall* from an engineering point of view. Supposing he wanted to know what rainfall you could get for waterworks, say at Leeds, Mr. Symons would probably want no more stations than he has. The organization has grown up with Mr. Symons, and it certainly will fail entirely with him. He was formerly for a time a clerk in the Meteorological Department, and his organization is certainly entirely dependent upon his life.

13,945. Do you consider his work important?—I think that perhaps too much is made of it, but I think that he has done a great deal of important work.

13,946. With reference to the water supply of a town, you would take into account the rainfall, would you not?—Yes; I may take a good instance, that of Middlesborough, a town which has risen in a few years. I do not know whether he would have enough stations there to supply the necessary information, but I do not see how 1,600 stations could be justified from an office such as ours.

13,947. As I understand that you consider it to be the business of the Meteorological Office to determine the rainfall for general meteorological purposes, but not to determine it for local purposes?—We cannot attempt to determine it for local purposes. If Mr. Symons ceased to carry on his organization and we had to undertake it, we might get a good deal of information, but it would not be done in anything like so minute a manner as Mr. Symons does it.

13,948. Is the Meteorological Office frequently consulted about legal questions, either in the Admiralty or in the other courts?—Yes, constantly in the Admiralty Court as regards collisions, and to a certain extent in the other courts. I may instance the case of a ladder being blown down in a certain storm at the East End, and we were written to and asked what was the force of the wind, and whether the fall of the ladder was justifiable. Constantly in cases of collisions one of our clerks has to go and give evidence with our observations if we have self-recorded observations.

13,949. Is any charge made for supplying that information?—None whatever, or rather none that touches the office. The clerk who goes as a witness gets a fee, but the office gets nothing whatever. If a serious amount of information is copied out the expense of copying is charged, but there is no fee whatever.

13,950. What other meteorological systems are there in existence at home besides those of the Meteorological Office and of the General Register Offices in London and Edinburgh?—There are a very considerable number of various kinds. There is Greenwich, which itself is only an observatory, not a system. There is the organisation of the Army Medical Department, which is at present being organised in conjunction with the Meteorological Office. There are certain stations under Sir Henry James of the Royal Engineers, and I believe the Navy Medical Department has some stations, but I am not sure about that. Then the Meteorological Society is organising a system, and the Scottish Meteorological Society has certain stations (in addition to those from which returns are published by the Government) connected with its Medical Department; and there is the Rainfall Organization, of which I have been speaking so much. But speaking of Government organisations, there are certainly three, and up to a recent time there was a fourth, Sir Edward Sabine's office, under the War Office, which is still called the Magnetic and Meteorological Department.

13,951. Do you think it would be desirable to centralise the systems which exist at present?—I think certainly so. There is no doubt that it was the unanimous opinion, both at Leipzig and Vienna, that there should be centralisation to increase harmonious action. I have a letter here from a man of very great eminence in meteorology, a gentleman in the colonies, Mr. Meldrum, of the Mauritius, and with the leave of the Commission I will read a portion of this letter, as

---

[* See Supplementary Evidence in Appendix III., p. 5.]

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

a colonial suggestion of what might fairly be done. What he says is this:—"If I had time, and were sure that, "there was any chance of the subject being taken up, "I could develope a theory as to what should be done "to promote meteorology in the British Empire. I "would (1), have a central office in London; (2), "partly convert the Kew Observatory into an in- "stitution for training meteorological and magnet- "ical observers, and discontinue the Meteorological "and Magnetical Department at Greenwich; (3), "obtain from Parliament an annual grant of at least "30,000*l.*; (4), have an arrangement made by which "the colonies would contribute, say, other 30,000*l.*; "(5), have the administration of the Imperial Fund "placed in the hands of some one or more persons in "London who should be responsible to Parliament; (6), the colonies to consent to the directors being "selected by the Central Office in London, and the "directors, with the advice of the Central Office, to "choose their assistants; (7), the observations, &c., "to be published in London."

13,952. What organisations of note exist in the colonies?—There is one in the Canadian Dominion under Dr. Kingston; there are various systems in Hindostan, the most important in Bengal, under Mr. Blanford, and in Bombay, under Mr. Chambers; the Madras organisation, under Mr. Pogson, one in the North-West Provinces, under Dr. Murray Thomson, and one in the Punjaub, under Dr. Neil. Then there are several in the Australian colonies and Tasmania. There is one for Victoria, I think, under Mr. Ellery; there is one for Tasmania, under Mr. Abbott; there is one in New South Wales, under Mr. Russell, one in South Australia under Mr. Todd, one in Queensland under Mr. MacDonnell, and there is one in New Zealand, under Dr. Hector. The organization of the Meteorological Society of the Mauritius, under Mr. Meldrum, is only that of an individual island, you cannot say it is an organisation; it chiefly interests itself in maritime meteorology. I may say that this organisation at the Mauritius has a different character from any other, because, as I believe, it first took its origin from a bequest. It was started by Dr. Thom. I do not know who gave the money, but the society has property independent of the Government at the Mauritius.

13,953. Has the Meteorological Office any stations at all abroad?—Certain stations. This commenced with the British Association. In 1857 the British Association recommended that anemometers should be placed abroad, and two were placed, one at Bermuda, which is there still, and one at Halifax, which was afterwards removed. Then the next important thing was that Lieutenant Rokeby went out in 1864 or 1865 to Ascension, and took about two years' observations there, and came back in 1867. Since then observations are now going on at Bermuda, and we have supplied certain instruments to the Bahamas, and to Sombrero. There were instruments deposited by Admiral FitzRoy at the Falkland Islands lighthouse at Cape Pembroke, and two in King George's Sound, in West Australia and Breaksea Island and Point King, but those two stations are only 7 miles from each other, I believe.

13,954. Does the Government sanction the existence of stations of this kind?—In the case of certain stations which are controlled by the Board of Trade, or the lighthouses which are controlled by the Board of Trade, and are considered home lighthouses, such as the Falkland Islands, Sombrero, and the Bahamas. The whole of the correspondence with West Australia is complete, and is to be found in the Minutes for 1873. There is nothing personal as regards the men, it is personal as between the colony and the office, as the governor considered that such a small colony as that should not contribute anything to the work, whilst the opinion of the Home Government was that the Home Government should contribute nothing.

13,955. Have any results of importance been derived from those stations?—Very important work as regards the anemometer at Bermuda. We have published the result of four years' observations at Bermuda in our last Quarterly Weather Report, and have got most important results from it, but there is very great difficulty in managing those stations from the impossibility of inspection. At the Falkland Islands the observations are very nearly worthless, they come in so very irregularly.

13,956. Have you any relations with foreign systems of observation?—We have very intimate relations of exchange with all the systems of observations, of the existence of which I am acquainted.

13,957. Is there any community of system among you?—We are attempting to make a community of systems. There is no system in existence that starts on the same principle as we do of requiring self-recorded observations from its individual stations, that wholly arose out of a meeting at Cambridge in 1845. The organizations are different in different places; in some places, as for instance, I believe, North Germany, the observers are paid a small sum, and in almost all systems the observers are called upon to do the preliminary calculations themselves, whereas in this country we do them all at the central office. Professor Dove's observers in North Germany are many of them schoolmasters; the observers of the Austrian organisation, which is very extensive, are, I fancy, in the position of country gentlemen. Some of them are gentlemen connected with religious establishments, others are doctors; in fact the average is rather higher than the middle-class observers that you will find throughout this country, and the Austrians are not paid. In France the organisation is in a very extraordinary state, indeed I may say that there is nothing organised at all. Instruments are supplied to the Ecoles Normales, but the observations are not thoroughly controlled, there is no proper organisation in hand in France.

13,958. Is there any pains taken to compare the instruments used by the British and Foreign observers?—Measures have been adopted at Vienna for that purpose, but the only steps that have been taken in this country have been that the standards at Kew and Greenwich, which do not agree exactly with each other, have been considered as standards to be compared, and foreigners have come here for that purpose, but we have not gone abroad to compare with their standards. There was a sub-committee appointed at Vienna for organization, and the report of that committee is to be found at page 61 of the Report of the Meteorological Congress at Vienna. At page 36 it appears that that report was adopted and received, and the matter has been referred to the Permanent Committee which now exists, to see how far perfect harmony can be brought into existence.

13,959. What was the first attempt at convening an International Conference?—A number of gentlemen were invited to meet at a meeting of the British Association at Cambridge in the year 1845. I do not think there were many oral deliberations there, but there is a good deal of correspondence printed in the Report of the British Association for the year 1845, which shows what took place at that time, and since the failure of that year was because they would not agree to harmonious working as to hours, out of that meeting arose our self-recording instruments; I do not know who besides Sir John Herschel and Sir Edward Sabine were the organizers, but amongst them were Professor Dove and Professor Kupffer, and three or four others. I can give a list of the gentlemen who took part in it. Perhaps I may mention that notice of that conference has generally been omitted, and it has been almost forgotten, but that was the first step long anterior to anything that has been recently done.

13,960. The last conference seems to have been at Vienna, in 1873?—Yes, it was held last year.

13,961. Has any action been taken to secure that the resolutions of the Vienna Congress will be carried out?—A permanent committee has been appointed to see what we are doing, and to arrange for summoning another Congress in three years.*

[* See Supplementary Evidence in Appendix III., p. 5.]

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

13,962. Are you a member of that Permanent Committee?—I am a member of that Committee.*

13,963. What advantages have been derived from those conferences, do you think?—The great advantage is getting to know the men, but we are gradually approaching towards uniformity. There is only one matter on which I had to stand up against the whole conference, until General Myer came, and that was the introduction of the metric system. The present position of the metric system, which is the point at issue, is that there are more stations in the United States, England, and its colonies than in the whole of the rest of the world put together,† and, therefore, it is the place of the advocates of the metric system to give way to us, instead of our giving way to them, as there would be more disadvantage in introducing the metric system than in introducing the English system everywhere; and of course, being under orders from the Government, I could not give the slightest sanction to any adoption of the metric system. But on all other questions there has been the greatest wish to work harmoniously with them. One important thing which would be worth noting has been the unanimous agreement that means are to be for five years, and for the same five years or "*lustra*;" that the first period of means will begin at 1871, and work till 1875, and the next will be from 1876 on. And we are trying to introduce an uniform scheme of publications, so that you can get the same sort of information from each country. We are gradually approaching each other each conference. We did something in this way at Leipsic, and perhaps more at Vienna. In 1873 there was a decided wish on the part of the members to give way if it was for the benefit of the public.

13,964. What is the amount of the annual grant to the Committee?—10,000*l.* a year.

13,965. Is that as much as was proposed by the Committee of Inquiry in 1866?—No; the Committee of Inquiry in 1866 asked for 9,900*l.* for the annual establishment and 2,900*l.* for outfit. The sum of 10,000*l.* was subsequently increased to 10,570*l.*, because that Admiralty grant had been omitted to be struck out of the estimate (the whole of that is stated in the correspondence in the Minutes for 1867). They allowed 10,570*l.* the first year, and 10,000*l.* every year after.

13,966. (*Professor Smith.*) A considerable sum is for outfit, is it not?—Yes.

13,967. (*Chairman.*) Did the Treasury give any indication of its wishes as to the operations of the Committee?—It is in the same letter, which, for this purpose, I may perhaps read; it is at page 55 of the Minutes of 1867. "My Lords will, however, consent that for "these purposes the sum of 570*l.* expressed in the "estimates to be 'for meteorological services under "'the Admiralty,' shall be available for expenditure "by the Committee appointed by the Royal Society at "the request of the Government in addition to the "sum of 10,000*l.* I am to observe that, in assenting "to insert the latter sum in the estimates for the "current year, my Lords were aware that they were "proposing a less sum than had been estimated for, "and they intended that the arrangements to be made "by the Committee should be curtailed accordingly. "It now appears that the Committee anticipated the "decision of this Board as to the exact amount to be "proposed in the votes when they gave orders for "instruments, &c., to be made. My Lords cannot "hold themselves responsible for these orders, and can "only regret that they were given before the Committee had ascertained the precise amount of public "money that they could look forward to for the "purpose."

13,968. Is the amount of the grant large as compared with the amounts allowed in other countries?—It is large as compared with the amounts allowed in most European countries, but in this document before me, which is the last Report of the Chief Signal Officer for the War Department of the United States for the last year, the amount allowed for that work for weather telegraphy alone is 50,000*l.*, exclusive of the salaries, which are all in the military vote. The amount allowed to us is certainly larger than elsewhere in Europe, but the work is different. Nobody else has anything like 2,000*l.* to pay for the marine work, and, as meteorological votes go, no doubt it is liberal as compared with other countries.

13,969. Can you give us an idea of what the grant is in Germany; take Austria for example?—There is no amount so large as ours. The whole vote, every penny that is spent, is accounted for by us, and there is no drawing salaries from other sources or anything of that kind. Moreover, the telegraphy is usually conducted free of expense abroad. I append the budgets for Russia and Austria (APPENDIX B).

13,970. Then we are to understand that the grant can in no way be described as a grant in aid of the Royal Society?—Not in the slightest degree. The Royal Society has nothing whatever to do with it. After the first year we wrote to have the title altered, and they did alter the title in the estimates, and put it down as "The Meteorological Committee of the "Royal Society." But as I said, it is not until the end of the seventh year that they have recognised that it is not a grant in aid, and that the whole expense is borne by the Treasury.

13,971. Then that title, "The Meteorological Committee of the Royal Society," is misleading?—It is appointed by the Royal Society, and the official title by which the Government call us is "The Meteorological Committee of the Royal Society."

13,972. Is any surplus refunded to the Treasury?—No. We were ordered, in the first instance, to re-pay the surplus. That was by a letter of the Treasury in Parliamentary Paper 240, 1867, page 13:—"I am "desired to say that in assenting to insert in the "estimates a lump sum of 10,000*l.*, my Lords under-"stood that the whole of the arrangements would be "undertaken by the Committee on their own respon-"sibility, and that no claims will be made upon the "public purse over and above what that sum will "cover, and that any saving out of that sum will be "surrendered to the Exchequer, as in the case of other "votes." Those are our original orders. At the close of the first year, when the financial year was out, I wrote a formal letter to the Board of Trade, which you will find in the Minutes for 1868, page 35, asking by whom the accounts were to be audited. The Board of Trade sent to the Treasury, and the Treasury wrote back to say that, "As the sum of "money placed at the disposal of the Meteorological "Committee of the Royal Society is considered as a "*contribution* towards the expenses of the researches "undertaken by them at the request of Her Majesty's "Government, it is unnecessary that the accounts of "the Committee should be subjected to audit on behalf "of the public." That carries with it the non-surrender of the balance.

There is one matter which perhaps I might mention with reference to almost my first answer. Our communication with the Government is with the Board of Trade, officially with the Secretary. We have no official access to the Treasury excepting through the Board of Trade, nor even with the Admiralty excepting through the Hydrographer. We are distinctly affiliated to the Board of Trade.

13,973. So that, although the Board of Trade will not own you, you do really, in a sort of irregular way, get at the Government through them?—Yes; and we never spend any money on a new object unless the Board of Trade order us to do so. If any money is asked for, supposing that a subsidiary grant were asked for by any person or persons, we should apply to the Board of Trade for leave to spend the money in that way.

13,974. Do you mean that you do not feel yourself

[* See Supplementary Evidence in Appendix III., p. 6.]

† Dr. Hann gives in his paper, "Fortschritte der Geographischen Meteorologie:—

Number of stations with English inches and Fahrenheit -	739
" " " metre and Celsius -	609
" " " Paris lines and Reaumur -	114

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

at liberty to administer the funds in your hands as you like ?—Not for such a question as to whether a new station is to be put on for storm warnings. For investigations, we are perfectly free ; but when a person makes a claim for an allowance out of this fund (say that a person asks me for new lanterns for a new station), we always say that the Board of Trade must sanction it.

13,975. Then, in fact, the Board of Trade is responsible for a large part of your expenditure ?—The Board of Trade protects us from non-scientific claims for expenditure. If any station wants storm warnings, we ask the Board of Trade whether that is such a station as should be authorized.

13,976. So that it does appear that, as to certain parts of your expenditure, you do not feel yourselves at liberty to do as you like ?—We do not, and we do not wish to, because we think that we should not be able to resist pressure from without.

13,977. To that extent the Board of Trade is really responsible for your expenditure ? — Yes, to that extent.

13,978. It does keep a control over your expenditure ; that is to say, if they refused their assent, you would not make a grant ?—Certainly.

13,979. How is the grant paid to the Commitee ?—As soon as it passes, I write a letter to the Secretary of the Treasury and get it.

13,980. What banking account do you keep ?—We keep a current account with the Bank of England, and a deposit account with the London and Westminster.

13,981. Does the Committee derive interest from the deposit account ?—Yes, we derived 186*l.* interest last year. The interest in the last year's report, owing to the bank rate being so high, was so large an amount.

13,982. Does the Committee keep a regular check on your financial position from time to time ?—It prints on its minutes quarterly statements of its liabilities, whilst a detailed monthly statement (*handed in*), when filled up, is handed in by me to the Committee to see how fast they are spending their money. That was carried on after the first year. They found that they did not know how much money they had to spend, and so this plan was devised. The quarterly accounts are abstracts of the monthly accounts, and if I take any one, say the last quarterly account which we have printed (I have not printed the one for the last quarter), we show that up to the 31st of December we have spent 7,500*l.*, and we have a liability of 1,200*l.*, making a total of about 8,700*l.*

13,983. Are the orders for work and so on given on an estimate accepted by the Committee ?—Any estimate for expenditure, excepting routine work, such as ordering new instruments, is always submitted by me to the Committee.

13,984. And are there contracts with instrument makers ?—We receive a very considerable discount on all instruments which we get for the public service. I order perhaps 100*l.* worth of instruments without asking the Committee. The instruments are kept on record, and there is a complete history of each instrument, but I do not go to the Committee for every supply of that kind. Anything new is always submitted to the Committee if it exceeds 5*l.* or 10*l.*

13,985. How are the cheques drawn and the accounts managed in the office ?—They are drawn monthly, and the accounts are all submitted to me, and countersigned by me, and then the cheques are countersigned by me before they are presented to the Committee for signature.

13,986. Does any member of the Committee sign them ?—Any one member ; but, as a rule, unless in case of urgency, or in case of absence, they are always drawn at the Committee.

13,987. And are they countersigned by a member of the Committee ?—The signature is by one member of the Committee, mine is only a countersignature ; but any one member will do, and the cheque is always placed upon the Minutes.

13,988. At what periods are the salaries paid ?—They are paid every month.

13,989. Are all the salaries annual ?—Some are, all those whom I have called clerks upon the establishment, as distinguished from those called temporary clerks, are paid according to annual salaries, the others are paid according to weekly salaries.

13,990. What proportion do the salaries bear to those in the public offices ?—That is an exceedingly difficult question to answer. My own impression is that the salaries are very considerably less than those in other public offices, even when compared with "supplementary" or "assistant" clerks.

13,991. Will you state with what other civil servants you have made the comparison ?—The Civil Service is in such a state of re-organisation at present, with a new Commission issued a fortnight ago, that one does not know what state it is really in. Those gentlemen who came to the office from the Board of Trade Department did so because no definite promise of promotion was offered at that time by the Board of Trade, but soon after they left a re-organisation of the staff at the Board of Trade took place, and they have lost materially by the change. However, the salaries are low compared with those in other public offices. Upon this point I beg to hand in the following table :

RETURN showing PROPORTION of SALARIES in METEOROLOGICAL OFFICE compared with those of other Offices. Data taken from Civil Service Estimates, 1874–5, and other sources.

Office.	Clerks.	Assistant Clerks, &c.	Writers, &c.
	£ £	£ £	£
Board of Trade -	200 to 800	80 to 400	—
Charity Commission -	90 „ 650	—	—
Civil Service ditto -	100 „ 500	80 „ 200	—
Greenwich Observatory	350†	†180 „ 250	—
Local Government Board.	90 „ 800	250 „ 400	—
Lunacy Commission -	100 „ 500	—	—
Patent Office - -	100 „ 450	130 „ 160	*150
Privy Council -	100 „ 800	90 „ 250	160 to 200
Registrar General -	300 „ 420	90 „ 280	*90
Stationery -	90 „ 500	—	*85

† Assistants. * Average.

The salaries in the Meteorological Office vary from 100*l.* to 250*l.* for clerks, and from 50*l.* to 100*l.* for temporary clerks.

13,992. Is there any allowance for over-time work ?—Yes ; the regulation about that is that no clerk is allowed to earn more than half his salary. Some of those who receive small sums could easily earn more than half their salaries, but such a state of things would be impossible for one of the senior clerks.

13,993. What regulations are enforced to prevent this work from interfering with the regular work ?—The regular work is never allowed to be done in over hours, except in certain cases, like telegraphy, but there are special investigations which are carried on besides the work of the office.

13,994. Is the system more advantageous to the office than the employment of extra hands ?—That is a very difficult question to answer, but we believe that it is on the whole more advantageous, because we have not room to put extra hands, and that would involve additional rent and additional supervision. Besides that, a man who is on the staff would be more likely to carry out our own ideas than a fresh clerk who would require a good deal of teaching. In fact our present staff have experience which the office would have to pay for if new men were engaged.

13,995. What are the financial arrangements with the observatories ? — The arrangements, speaking generally, were, that every observatory was to get 250*l.* a year for doing the work, but that has been modified

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

in two cases. In the case of Armagh, Dr. Robinson is only paid the amount which he is out of pocket by the salary of his assistants, and his chemicals. In the case of Valencia, we have to bear the entire expense, and the cost of that very closely approaches 600*l.* a year, solely because we have to pay the whole 250*l.* as salary to get a superintendent to live there. I may say that it is the cost and expense which has prevented us from establishing a station in Caithness, Orkney, or Shetland, or anywhere far north. There is no existing observatory to which they can be affiliated. But in the other cases we simply allow the 250*l.* to be spent as they choose. They have to find their chemicals and their assistants, and to keep the instruments going, for small repairs. For instance, when a thermometer is broken it has to be paid for, because it is caused by carelessness.

13,996. What financial arrangements do you make with other observers?—Some of the gentlemen who superintend the anemometers and self-recording instruments for us are paid something like 10*l.* or 15*l.* a year, but not more than that.

13,997. Does the office pay for the transmission of its telegrams?—It does pay almost entirely, as a private person, excepting that we do not pay the money down; we pay at the end of the year, or we pay quarterly.

13,998. Is there any reduction of cost in the case of office telegrams?—Recently there has been. In the case of the companies we had a considerable reduction of 30 per cent. The Government withdrew that, and lately they have begun themselves to utilize some of our returns, and they allow us to be charged at press rates for all observations which they can themselves utilise. There were certain returns of wind and weather formerly furnished to the Press Association by the Post Office which were not very satisfactory, and we offered to give them copies of our returns if they would give us the boon of press rates. But at present for storm warnings and everything else we pay simply 1*s.* for each message of 20 words.

13,999. What would be the saving if the Government were to forego this charge?—We believe about 1,100*l.* annually for simple transmission; but of course we do not consider the idea of foregoing the whole charge for telegraphy which amounts to nearly 3,000*l.*, as that includes the charge of the payment of observers, and discussions, &c.

14,000. Would not a reasonably free use of the telegraphic wires enable you to receive and issue intelligence much more satisfactorily than at present?—Certainly. We only get now one telegram per day from all stations, and from a few selected ones two, but in case of a sudden storm we cannot get information enough, owing to its cost. I may also say, that every storm-warning that is sent all round the coast costs us nearly 5*l.*, so that it comes to be a serious question of expense, how often one can modify those messages.

14,001. That constitutes a sort of practical drag upon your sending information?—Yes. I put down 7*l.* because there are about 130 stations at 1*s.* a-piece.

14,002. Would you prefer such an indirect allowance to an increased grant of equal amount?—I certainly would prefer a grant of equal amount, because I should still be absolute over the observers, but if I am to be dependent on the Post Office for the observations, and they receive nothing from me, I shall be unable to get a man removed, or, what is more important, to keep a good man if the Post Office wants him elsewhere. I think if we were put in connection with such a large office as the Post Office, we should be unable to manage the thing efficiently in a scientific point of view.

14,003. If I understand the suggestion properly, this "reasonably free use of the telegraphic wires" means simply that the observers whom you do employ should be able to communicate with you more frequently than they do, and without expense?—Without additional expense. The Post Office would consider then that those would all come as official messages, and they would consider that they furnished them, although they got no pay for them, and they would not care about the work.

14,004. Is any work done for other parties, such as foreign institutions, upon commission?—To a great extent. For instance, Mr. Meldrum has received from us a considerable quantity of information for certain charts, which I shall speak about subsequently, and there is a certain amount of work done in the way of copying and furnishing information. A very serious matter arises about that, because we are asked by the Foreign Maritime Meteorological Offices to furnish, free of charge, all the information that they may require to discuss. We are the collecting party, and they have got discussing power, but the whole of the time of our clerks would be taken up copying if we complied with their request; we simply charge the cost of copying, and the cost of all the work done is charged to the people who give the commission.

14,005. Is such work always charged for?—Unless it is in the way of exchange. For instance, if an office like the Observatoire National of Paris sent us a very large supply of information from its own stations of a different nature, we should not charge them for the exchanges, or it would be on a lower scale; and also if it is a very small thing we do not make a charge.

14,006. What are your rules about the supply of unpublished information?—Anyone who chooses can get it by paying the cost of the copying, and when he publishes it, saying that he has got the information from the office.

14,007. The balance sheet for 1872 shows on the debtor side a sum exceeding 200*l.* received, can you explain to the Commission those entries?—We get very considerable orders for instruments for public institutions abroad. For instance, for Dr. Kingston there are outstanding orders considerably exceeding 100*l.*, indeed I think as much as 200*l.*, for instruments for the Canadian stations. The whole of those instruments are ordered by us, and the money passes through our accounts, so that our balance sheet rises to 10,200*l.* by these transactions instead of 10,000*l.*

14,008. Is there any profit to the Committee upon such transactions?—No monetary profit; I have got a very large order at present (although this will not pass through our accounts) from the Admiralty of Berlin for instruments connected with the transit of Venus. It is simply done as a matter of friendship. The orders are made payable to me, but nothing whatever, excepting the cost of actual work in the office in packing, &c. is charged.

14,009. Is there a serious want of extra funds?—I should say a very serious want for working the office thoroughly, as regards carrying out investigations. I think that the estimate of the Committee of Enquiry did not provide anything like sufficient for the clerks; even allowing for all the salaries, there is nothing like enough men. I think there was an insufficient staff originally contemplated. We have not been able to carry out the ideas which were contemplated by the Royal Society originally, as regards many discussions and investigations which were to be carried out. The Observatories are calling out for more money. Then, as to the question of telegraphic stations, it is very much wanted to increase their number, and there is money wanted for experiments.

14,010. There are two series of experiments being carried on by me: one by aid from the Government Grant, and the other at the expense of the Meteorological Committee. The one by the Government Grant is on anemometers. The Meteorological Committee have got thermometers on the Pagoda in the Royal Gardens, Kew, at various heights to test the influence of elevation on their indications, and we should very much like to be able to spend some money if we had it on testing thermometers, and on various physical

R. H. Scott, Esq., M.A., F.R.S.

22 April 1874.

experiments connected directly with our Meteorological Observations.

14,011. Where is the habitation of the Meteorological Office?—Formerly, up to the year 1869, we held the old office in No. 1 Parliament Street. In 1869 we received notice to quit, and we took two flats in 116 Victoria Street, and then afterwards took a third.

14,012. Do you pay rent for them?—Yes.

14,013. A heavy rent?—We pay less there than we should pay for very much worse accommodation in Parliament Street. We paid 538*l.* 17*s.* last year.

14,014. That forms a considerable item in your expenses?—Certainly.

14,015. (*Professor Smith.*) I see that you derive some income from subscriptions for your charts?—Yes.

14,016. Is that source of income increasing or not?—It is not materially increasing. I think one might say that it is not much above 300*l.* a year that we get from the charts, and this barely pays the postage. It is as I say not materially increasing, but it is keeping on very steadily. We have an issue of upwards of 500 copies, but that is a question which will come on subsequently. There is no doubt whatever that these charts have materially improved the position of the office with the country, they are very popular.

14,017. How is the expenditure created for the marine observations?—Last year's account will give the best idea for the whole year. That would include Captain Toynbee's and the clerks' salaries, but it includes also the cost of new instruments and repair. The abstract of accounts shows 400*l.* for the superintendent last year, 300*l.* for the supply of instruments to the Admiralty, 500*l.* for the supply of instruments to the Mercantile Marine, and 970*l.* for discussion and reductions.

14,018. How does that 900*l.* for discussion arise; who makes that charge?—There is the clerk at a salary of 230*l.* for taking care of the instruments; there is the head clerk at 250*l.*; and there is another clerk at 150*l.*, and there are three juniors at less than 100*l.* a year each, speaking roughly.

14,019. Do you consider that that account of returns that you have now stated indicates success in that department and the duties of the office?—The case as to that is that we are discussing the work which was collected in the office in former times, and have derived important results from it, while the Committee of Inquiry recommended that the work of dealing with the old materials should be subservient to working with the new.

14,020. (*Dr. Sharpey.*) Is there a large accumulation of materials?—A very large accumulation, about 3,000 logs. We find that the material which we now get is very small in quantity, but it has materially changed its character. We cannot get so many observations round the Cape of Good Hope, because the number of ships taking that route has greatly decreased. The Suez Canal has altered that. The use of steamers, which is increasing every day, materially affects the correctness of the observations of wind. We cannot get a knowledge of the wind so well from modern logs. We found that the old logs, when they have been sifted, formed a most important mass of materials. I think subsequently, when we are speaking of the usual work, I will explain at a little more length the way in which we have had to work, and I have brought a chart with me which will show some of the questions about this matter.

The witness withdrew.

Adjourned to to-morrow at 11 o'clock.

APPENDIX A.

LIST of METEOROLOGICAL STATIONS now in communication with the Meteorological Office, compared with those now in communication with the Registrar General. The stations are arranged according to their counties and countries.

No observers in connexion with Registrar General's office have been *specially* asked to join Metorological Office for this return.

ENGLAND AND WALES.

Counties.	Meteorological Office Stations.	Registrar General's Stations.
Cumberland	Silloth	Silloth. Carlisle. Cockermouth.
Lancashire	Stonyhurst Observatory. Southport.	Stonyhurst. Eccles.
Cheshire	Liverpool Observatory, Bidston.	Liverpool Observatory, Bidston.
Flintshire		Hawarden.
Caernarvon		Llandudno.
Anglesey	Holyhead.	—
Cardigan	Aberystwith	Lampeter.
Pembroke	St. Ann's Head.	—
Gloucester		Gloucester.
Somerset	Portishead	Taunton.
Cornwall	Scilly (St. Mary's). Helston Falmouth Observatory.	Truro. Helston.
Devonshire	Barnstaple Plymouth	Barnstaple. Sidmouth.
Channel Islands	Guernsey Jersey (St. Helier's).	Guernsey.
Hampshire	Hurst Castle Lymington	Bournemouth. Lymington. Osborne (I. W.) Strathfield Turgis. Aldershot.
Sussex	Brighton Crowborough Beacon	Worthing. Brighton. Eastbourne.
Kent	Acrise (near Folkestone).	Greenwich Observatory.
Suffolk		Somerleyton.
Norfolk	Norwich Yarmouth	Norwich. Holkham.
Yorkshire	Hull Scarborough York Moorside Sheffield	Hull. Moorside.* Bermerside.* Bradford. Leeds.
Durham	Seaham.	—
Northumberland	Allenheads	North Shields. Bywell. Allenheads.
Notts	Nottingham	Nottingham.
Derbyshire		Derby.
Stafford	Oscott.	—
Cambridgeshire	Cambridge Observatory.	Wisbeach.
Hertfordshire		Royston.
Bedfordshire		Cardington.
Oxfordshire	Oxford	Oxford.
Berkshire		Streatley.
Wiltshire		Marlborough. Salisbury.
Surrey	Kew Observatory	Weybridge. Battersea.
Middlesex	Chiswick	Chiswick. Camden Town.

SCOTLAND.

Hebrides	Stornoway (Island of Lewis).	—
Orkneys	Sandwick Manse.	—
Shetlands	Dunrossness (Sumburgh Head).	—
Inverness		Culloden.
Nairn	Nairn.	—
Aberdeen	Aberdeen Observatory.	—
Lanarkshire	Glasgow Observatory.	—
Ayr	Annanhill (Kilmarnock).	—

IRELAND.

Donegal	Moville. Dungloe.	—
Sligo	Markree Castle.	—
Galway	Galway.	—
King's County	Parsonstown.	—
Kerry	Valencia Observatory.	—
Cork	Roche's Point (near Queenstown).	—
Dublin	Dublin. Kingstown.	—
Down	Armagh. Donaghadee.	Miltown (near Banbridge).

* These two stations are *very* close together.

APPENDIX B.

ALLOWANCES IN AUSTRIA AND RUSSIA FOR METEOROLOGICAL OBSERVATIONS.

Austria (1869):	£	s.	6.			
* Director	210	0	0			
* First assistant	130	0	0			
† Second ,,	110	0	0			
* Assistant	42	0	0			
* Messenger	37	16	0			
Computers	54	15	0			
				584	11	0
Instruments, &c.	120	0	0			
Registers	160	0	0			
Inspectors	40	0	0			
Remuneration to observers	20	0	0			
				340	0	0
Draughtsman	48	0	0			
Telegraph messengers	24	0	0			
,, expenses	12	14	0			
				84	14	0
				£1,009	5	0

* Residences provided at the Central Meteorological Institute.

† With allowance of 22*l.* 10*s.* for residence.

St. Petersburg (1872):	£	s.	d.
‡ Director	282	10	0
Assistant	217	10	0
Observers	625	0	0
Computers	125	0	0
‡ Secretary	125	0	0
‡ Intendent	78	12	0
Engineer	70	6	0
Scientific purposes	937	10	0
Inspections	187	10	0
Printing	625	0	0
Office contingent expenses	781	5	0
Maintenance of Meteorological Stations	625	0	0
	£4,680	3	0

‡ These have residences provided at the Observatory.

R. H. Scott, Esq., M.A., F.R.S,

22 April 1874.

Thursday, 23rd April 1874.

PRESENT:

THOMAS HENRY HUXLEY, Esq., LL.D., Sec. R.S., IN THE CHAIR.

BERNHARD SAMUELSON, Esq., M.P.
WILLIAM SHARPEY, Esq., M.D., F.R.S.
GEORGE GABRIEL STOKES, Esq., M.A., LL.D., Sec. R.S.
HENRY JOHN STEPHEN SMITH, Esq., M.A., LL.D., F.R.S.

BALFOUR STEWART, Esq., LL.D., F.R.S., further examined.

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874

14,021. (*Chairman.*) Has anything occurred since you were last before the Commission, to lead you to wish to add anything to what you then stated on the question of meteorology ?—To some extent the position of things has changed since then; for instance, I stated in my last evidence that one great disadvantage under which meteorologists laboured was the difficulty of procuring individual observations, except at very great expense. Being anxious to do what I could to remedy this grave inconvenience, I was the means of getting a petition signed and presented to the Meteorological Committee, and they have now acceded to the prayer of this petition, and, beginning with the present year, they are prepared to publish the individual values derived from their self-recording instruments. There is another point in which the position seems to be changed. At the time when I last gave evidence I did not think that regular observations were made with regard to Atmospherical Electricity excepting at Greenwich and Oxford. I hear now, however, that the self-recording instrument of the Meteorological Office for electricity is complete, and I hope that soon we may have continuous electrical observations undertaken by that body. I know it was in contemplation some time since that they should undertake that work whenever their instruments were complete.

14,022. Has anything been done with respect to observations of the sun's heating power ?—None, with respect to the sun's heating power; the instrument, so far as I can see, requires to be devised for that purpose. But with regard to the sun's actinic effects, Dr. Roscoe has devised a self-recording instrument, which he hopes will soon be adopted, and already the Kew Committee, Mr. Meldrum, Director of the Mauritius Observatory, and Mr. Ellery, Director of the Melbourne Observatory, have promised to give a trial to this instrument. Besides this, another instrument of his construction, not self-recording, is already adopted to some extent in the Russian Observatories.

14,023. The Meteorological Office, I believe, has done nothing with regard to actinic observations, or with respect to the sun's heating power ?—No, nothing. There is another point in which I think advance has been made. At the moment when I gave my evidence the photographic observations of the sun's disc which had been taken at the Kew Observatory for 10 years were just discontinued, but now I am given to understand that similar observations are regularly taken at Greenwich by Sir George Airy, and I think that very probably observations of the same kind will be undertaken in India and in the Mauritius. Also I think that Mr. Langley, the Director of the Alleghany Observatory, in America, may possibly undertake observations of the same kind. After the transit of Venus we shall probably have a good many photoheliographs at our disposal, and it is possible that some more extensive use will be made of those photoheliographs after the transit of Venus has taken place.

14,024. Do you think that the Meteorological Office ought to take charge of those instruments, and to utilize them ?—I am not sure that the Meteorological Office ought to do so. Although I have no doubt that solar observation is intimately connected with meteorology, it is questionable whether they should be put together. In my opinion, an institution for the purpose of solar observations would be better than that the thing should be taken up by the Meteorological Office.

14,025. In a special observatory ?—Yes, in a special observatory, probably with head-quarters in this country, and with certain stations in our different colonies, one great object of which would be to render it quite certain that we should have every day a record of the sun's surface either at one station or at another.

14,026. Where would such an institution as that be lodged ?—Supposing it were lodged in this country, such an institution, if it were to take charge of the sun, would require to take spectroscopic, as well as photographic observations, probably in some place where the climate was most favourable. Of course climate is at a disadvantage as far as this country is concerned; but, on the other hand, being near the

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

centre of scientific work in England is a counterbalancing advantage.

14,027. If you could not have those advantages, this country would not be a good place to establish such an observatory in?—No, I should not think it would be a good place to establish such an observatory in.

14,028. Would such an observatory as that be a very costly institution?—No, I do not think it would be very costly.

14,029. You would have such an institution as that kept entirely apart, would you not, from the Astronomical Observatory?—Yes, I would have it kept entirely apart.

14,030. And not under the control of any of the existing head institutions?—No, I think not.

14,031. Do you suggest that the aid of the Government is needed more especially for one branch of meteorology as compared with another?—I think that, as far as I can see, the subject of Meteorology naturally divides itself into two heads. There is first of all physical meteorology, of which the object would be to ascertain the physics of the earth's atmosphere, and perhaps of the earth's ocean; and then there is climatic meteorology, which has a number of branches, each relating to different human interests. It might be an advantage, for instance, to study certain particulars with regard to disease, or with regard to agriculture, or with regard to fisheries, particulars that might be different from those which would be required for the study of the physical meteorology of a country. It appears to me that the most legitimate object for Government aid is physical meteorology; that is a branch of the subject which certainly could not be studied to advantage by private individuals, and it necessarily calls for Government action.

14,032. I suppose that the business of the physical meteorologist would be rather to explain phenomena by the application of the laws of physics?—Yes; first of all to collect the phenomena properly, and then also to explain them.

14,033. (*Professor Smith.*) Will you describe to the Commission the exact difference between the two terms, physical meteorology on the one hand and atmospheric and climatic meteorology on the other?—For instance, with regard to living beings, I am not sure that it is known exactly in what way the constituents of the atmosphere may be supposed to affect the human body or the various plants, and an investigation with regard to that would appear to be very different from any investigations with regard to the physical causes of the motions of the earth's atmosphere. Then, with regard to mines, explosions, fisheries, agriculture, and to all the various interests, there are various observations which should be made; but I question whether those different branches have advanced to such a point as to render it desirable that such observations should be undertaken by any central authority at the present moment. One sees very well why a central authority should be necessary to obtain the physics of the earth's atmosphere, but I cannot say that I think a central board could undertake those other points so well perhaps as local boards, who are more especially interested in certain localities. I do not think that the science has developed sufficiently to warrant the construction of a central board.

14,034. (*Chairman.*) Do you think that those subjects fall into the province of the present Meteorological Office?—I should be inclined to think that the Meteorological Office would do better to confine itself to physical meteorology alone. It evidently occupies a position of strength if it does so, because it is quite unquestionable that private individuals could do nothing to occupy the same position. If, however, it extends itself for instance to making investigations in certain localities with regard to mines or fisheries it occupies a position, as it appears to me, which is very much more open to objection.

14,035. Would you organize the Meteorological Committee in any really different form to that which at present obtains?—I should be inclined to dispense with the Meteorological Committee altogether, and substitute a Meteorologist Royal, or whatever his appellation might be, a single official who should be responsible to the Government in the same way as the Astronomer Royal is responsible for his department. I do not see why the one department should be on one footing and the other department on a different footing. I think that there are grave disadvantages with a department administered by an unpaid committee.

14,036. Would you appoint a Meteorologist Royal corresponding with the Astronomer Royal?—Yes, whatever the name might be; I should appoint an official very much corresponding to the Astronomer Royal and responsible to the same extent. A Board of Visitors would not be objectionable, but the direction of an unpaid Committee appears to me to be very objectionable.

14,037. Would you leave the other branch of the subject, climatic meteorology, to individuals and loca efforts?—Yes, I think so, possibly supported to some extent by funds from the Government, but I should not put such branches under the superintendence of a central board at the present moment.

14,038. For example, what would you say with regard to those observations that are at present published by the Registrar General?—This is a matter which I think ought to be decided by the Registrar General.

14,039. The question arises in this way: the Registrar General is a public officer, who has to be paid out of the public money; the Government naturally says, Here is a body to which we grant a certain large sum, and we do that instead of our being required to pay all the separate items?—As far as the money is concerned, I consider that a mere matter of detail, but I should be very strongly against the Meteorological Committee undertaking anything but Physical Meteorology; I think that they ought to confine their labours to that. If they at present undertake all those branches of meteorology bearing upon the various individual human interests, it appears to me that you will leave them no energy to attack the problems of physical meteorology. I think the great point is to put physical meteorology somewhat more into the position of a branch of physical science; at the present moment it appears to me to occupy a very low position indeed.

14,040. (*Dr. Sharpey.*) Do you consider that the practical applications of meteorology should be conducted by private individuals entirely; for instance, would not the telegraphing of the weather require a central establishment?—Yes; I think that weather telegraphy as at present undertaken by the Meteorological Office certainly ought to be continued to be undertaken by them, but I should even imagine that when the thing is properly developed, when the laws are properly understood, it would then become simply the working out of some physical law, which might ultimately be detached from them altogether. At the present moment, what they undertake is to convey information, and that is a thing which requires, from its peculiar nature, to have something like a centralised office in order to undertake it. You have all those stations in different parts of the kingdom, and correspondence with the different stations abroad, and in order to get that information, I do not see that it could be undertaken except through the Meteorological Office. At the present moment I should say that that is a very legitimate subject for that office to undertake.

14,041. It may be a long time before you could deduce the applications?—Yes, it may be a very long time.

14,042. (*Chairman.*) The observations which are collected for the Registrar General have to be brought to the central office, have they not? The collecting and reducing them does not take very much trouble. It is almost clerical work, is it not?—Yes. The collecting and reducing them does not take very much trouble; but if it is supposed that the object of the Meteorological Committee is, as a matter

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

of principle, to be confined to physical meteorology and those branches of meteorology which could not well be undertaken, except through an agency of that kind, it appears to me that it would be detrimental to the office to dissipate its energies by the consideration of problems which really are more connected with the other branch of meteorology than they are with the physical branch.

14,043. The point is, whether it would be really a dissipation of energy, and whether such work as you have just been referring to might not be managed by persons who were not occupied with those higher problems in the office?—I think that that is simply a matter of detail. The Registrar General, I imagine, at the present moment, is responsible to the Government for the information, and it is a matter of detail upon which I should not feel myself competent to give evidence. I should leave that to him. He is the responsible person. Let him get any person that he thinks best to undertake the publication of those observations. I do not think that it should be undertaken by the Meteorological Office as the Meteorological Office. If there are individuals there who seem to satisfy the requirements of the Registrar General, I think that that is a point for him to determine.

14,044. The question takes a practical shape, as it comes before the Government, in this way: a sum is put down in the Estimates for getting Meteorological Observations for the Registrar General, and the Government immediately say, We pay 10,000*l.* per year for getting meteorological observations, why should not the Meteorological Office do it; why are we to be called upon to pay a separate sum?—If that is the shape that the question takes, it would be a perfectly sufficient answer, from my point of view, to say the Meteorological Office ought to confine itself to physical meteorology, and this is not a branch of physical meteorology. Meteorology has come to that stage, that physical observations ought to be taken by an office that confines itself to that purpose.

14,045. Would you leave climatic meteorology altogether to societies and to individual effort?—At the present moment it appears to me to be a matter that might best be left in that position, and that a central authority would do no good in a question of this kind, but rather do harm; in fact, rather tend to depress than to encourage these local efforts. I have no doubt that a great deal might be done by the zeal of local individuals, but if the thing were undertaken in its present state by a central board, which would do little but register a number of observations, I do not think that any good would at the present moment be done.

14,046. For example, the Scottish Meteorological Society has made a proposition to collect a number of observations of the kind to which you are now referring, and they ask for a certain subsidy on that ground; do you think that that would be a desirable way of giving aid to that particular branch of meteorological science?—I think it would. It appears to me that the Scottish Meteorological Society are doing a great deal of good. I know at any rate that Mr. Buchan, the Secretary of that Society, is a very distinguished meteorologist, and there are a number of persons in Scotland who take very great interest in some of these points. The Marquess of Tweeddale, the President of that Society, takes great interest in some meteorological points in connexion with climatic meteorology in its relation to agriculture and the fisheries, and I think that, under present circumstances, it would be a good thing to encourage those local efforts that are taking such a hold upon the mind of the meteorologists of Scotland.

14,047. So that if the Government aid is to be given to climatic meteorology, you would rather have it in the shape of subsidies to societies?—Yes.

14,048. Do you think that the sphere of operations of the Meteorological Office should be extended to the obtaining of information regarding the less frequented oceanic regions?—I think that ultimately, if meteorology is to become a science, we should obtain information regarding the less frequented oceanic regions; but I should not be prepared to say that in the meantime any definite steps should be immediately taken with regard to that. It is a subject which requires more thought than I have bestowed upon it, and it ought to be left to develope itself more gradually. The point that I should wish to bring before the Commission at the present moment is the fact that if meteorology is ever to obtain rank as a physical science, we ought to have sufficient general knowledge of the meteorology of our globe. At the present moment it appears to me that the knowledge that we obtain, for instance, of the oceanic regions, is very much like the kind of knowledge that we obtain of the meteorology of a country by taking observations as we are being carried along its various highways or in railway trains; we get a few observations in the most frequented regions, but the other regions are almost utterly unknown.

14,049. Would you recommend the undertaking by the Government of special expeditions to extreme northern and southern regions?—I should recommend the undertaking of such expeditions by the Government, and I think from a number of points of view that such expeditions are very desirable.

14,050. (*Professor Smith.*) With reference to the publication by the Meteorological Office of the individual values in the observations, which I think you stated you had urged upon them, is that a very expensive operation?—I obtained some preliminary information with regard to its expense, and I think, as far as I can see, it would not take more than 150*l.* a year for the mere printing. It would take some clerk's work in the office in order to get the thing into shape, but how much additional clerk's work I am not prepared to say. The mere printing of 100 daily copies would not take more than 150*l.* a year.

14,051. Do you state that as yet there are still no records of atmospheric electricity excepting at Greenwich and Oxford?—Not yet, but I hope the Meteorological Office will very soon have such.

14,052. With reference to climatic meteorology and any assistance that might be rendered by the Government to it, you seem to be of opinion that any such assistance that was rendered for the northern part of the kingdom would perhaps be most properly rendered by means of the Scottish Meteorological Society?—I should imagine it would under present circumstances.

14,053. Do you think that there is any voluntary association, or any body of persons in England, who could be employed to render the same service in England that the Scottish Meteorological Society might render in Scotland?—There is the Meteorological Society in England.

14,054. To come to physical meteorology, supposing the Meteorological Office, with its duties, were strictly confined to physical meteorology, would the plan of operations that you would recommend be something similar to what exists now; I mean a certain limited number of observatories over the country?—I think so; I should not be prepared at the present moment to advocate any very great change. There may be deficiencies, but in such a case, when the observations were properly reduced and discussed, we should be in a better position to see what points were deficient and what points might be supplemented by further observation.

14,055. You would wish that those observations on atmospheric electricity, the sun's heating power, and actinic observations should be taken at most of the meteorological observatories?—I think that electrical observations stand upon a somewhat different footing from observations of the sun's heat, and actinic observations. If, for instance, there was a physical observatory for the sun I should imagine that actinic and also heating observations might be put under that observatory, supposing there was an instrument for recording well the observations of the heat of the sun.

14,056. Observations on atmospheric electricity ought, you think, to be taken by meteorological obser-

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

vatories generally?—Yes, no doubt. The processes for doing it would be quite analogous to the processes connected with their other instruments, and I have little doubt that the Meteorological Committee contemplate doing so, in fact, I was led to believe, when I was connected with them, that that was one of the things which they contemplated doing when they got a perfect instrument, and I understand that now the instrument has been pretty nearly rendered complete.

14,057. I understand you to recommend that the Government should continue to do what it does, that is, really to support physical meteorology even more largely than at present?—Yes, I think so.

14,058. Do you think you could state any special claims that that science has upon the Government for its support as compared with other branches of physical science?—I think the claims would be that when the laws regulating the motions of the earth's atmosphere come to be much better known than they are at the present moment, immense benefits of a material kind might be expected to flow from the proper appreciation of those laws. For instance, Mr. Buchan, the Scottish meteorologist, showed that there was a connection between the disposition of the isobaric lines and the weather. He showed that on one occasion, when there was an intense cold that came over this country one winter, there was a very low barometer here and a high barometer in the region of Siberia, and consequently there was a transmission of colder air from those cold regions to the regions here. It seems to me that things might be put into such a state that we might anticipate the advent of such weather, probably for some days. That is one of the possible things, and it seems also possible that if the science developes we might perhaps ultimately be able to tell what kind of season might be anticipated. I do not mean to say that we shall ever be able to prophesy stormy weather much in advance, but at any rate we might possibly bring things to such a state that we might be able to tell to some extent what kind of season would be most probable.

14,059. Will you be so good as to state your opinion as to the value and desirableness of keeping up the observations of rainfall which have hitherto been carried on by a Committee of the British Association?—It appears to me that these observations of rainfall are of very considerable value. I am not quite sure whether their value is not more connected with the climatic branch of meteorology, than it is with the physical branch of meteorology, but to some extent the observations have a physical bearing as well as a climatic bearing. There is no question that it is a case where locality enters very widely into consideration. At the present moment it appears to me that they have been exceedingly well undertaken by Mr. Symons. I do not know whether he would be inclined to give them up if he did not receive support. I have no doubt that he would prefer to undertake the continuance of those observations himself, provided that he received some little pecuniary support in some way.

14,060. You would prefer on the whole to see that system of observations carried on by voluntary associations, assisted it might be by the Government, rather than to see it placed under the Meteorological Office?—I should.

14,061. (*Professor Stokes.*) What do you conceive to be the objections to the management of the Meteorological Office by an unpaid committee?—When the Meteorological Office was reconstituted, Government naturally consulted the late President of the Royal Society, Sir E. Sabine, who was at the same time an old and active meteorologist. Naturally, also, Sir E. Sabine had a voice in the nomination of his colleagues, who composed, along with himself, the Meteorological Committee. These colleagues were men of scientific standing, and of business habits; but, although interested in meteorology, they were not all meteorologists. They very naturally chose Sir E. Sabine as their chairman. When in the course of time Sir E. Sabine proposed a method of reducing the observations accumulated by the Committee, it might have been thought by those of the Committee who were meteorologists that the science had developed sufficiently to render something more necessary than his method, yet the constitution of the body was such that Sir E. Sabine was able to carry his views. These views of course came officially before the public as the views of a body of men who were selected as best qualified to conduct the meteorological affairs of this country. I presume that if any question had been raised in an official manner about the views of the Committee, they might have replied that had they been selected for their task by competent authorities, that they spent a great deal of time in superintending the Office, for which they received no remuneration, and that if Government were not pleased with their manner of conducting the Office, they had better make some other arrangement. In fact, it appears to me that an unpaid body of men cannot be held responsible in the same way as a single responsible and salaried official.

14,062. Do you conceive that such an object as a comparison of the general temperature of the different seasons of the year, with regard, for instance, to the public health, could be better accomplished by a limited number of stations at which continuous observations were taken, or by taking the average of a very considerable number of stations scattered over the kingdom, and managed by amateurs?—It appears to me that the information which we get from the self-recording instruments is rather of a differential than of an absolute character. It tells us of certain fluctuations. I am not sure that I should absolutely rely upon the records of such instruments as giving any idea of certain peculiarities of the climate of any place that might affect individuals or that might affect plants. It appears to me that, on the whole, the information derived from them is rather of a differential than of an absolute nature. In order to have all the peculiarities of the country properly represented, you might require to have a great many observations very near one another in different localities; for instance, take Sandown and Ventnor in the Isle of Wight, those places are near one another, but I imagine that Sandown has rather a bracing climate while Ventnor has a very relaxing one.

14,063. My question referred to the average climate throughout the kingdom, because it is obvious that for any particular locality the observations that are taken there would show the climate of that locality better than any average obtained from the kingdom; but for general averages for general national use my question was whether such could be better obtained from a few stations at which observations were taken under authority upon which we could rely, or whether it was requisite to take the mean of observations at a great number of places, for which we should have to depend upon the observations of amateurs?—I think, in order to get proper information about the climate of the country, certainly some check ought to be kept upon the observations. We should be sure that the observations are tolerably good. You must visit the places occasionally, and see that the instruments are in good order, and that the observations are properly conducted.

14,064. Do I understand you aright to say that you think that the best result would be obtained by numerous stations, even although you should have to depend for the results there obtained upon amateurs, provided you had a person to visit them so as to check the mode of taking their observations, rather than by a few stations in the kingdom which were under a central management, and the results obtained at which were sent to the managing body to be dealt with as a check upon them?—I do not think that observations at a few places would meet a case of this kind. You would require to have a number of places. If you take the self-recording instruments of the Meteorological Committee, what, for instance, actuated the chairman of that body to fix upon those places? He knew that certain bodies in these places were not only capable to conduct such observations, but certain to have con-

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

venient rooms where observations of that kind could be carried on. Stonyhurst was one, Kew another, and for a similar reason Glasgow, Aberdeen, and Armagh were selected. The choice had not much reference to climate, with the exception that the observatories were spread at certain distances over the kingdom, one being in the south-west of Ireland, where the weather comes from the Atlantic. Thus, other considerations than the considerations of mere climate induced the Committee to fix upon those stations. I should not consider that results derived from the self-recording instruments at those stations would afford good evidence with regard to peculiarities of climate.

14,065. You mean as regards the temperature, and not merely as regards the rainfall, because the rainfall is so very local?—Yes, the rainfall is so very local, and the temperature is very local too. It appears to me that the barometer is an instrument that is not so local; but some curious fluctuations in temperature take place, and if there were two thermographs, one at one place, and one at another very near to it, you might get very different results. I think we tried that at Kew, putting one in the observatory and one in a small house outside, but the thermographs did not exhibit the same fluctuations at the same moment. You got fluctuations, but not precisely analogous fluctuations.

14,066. In the mean temperature, as recorded by the two, was there any particular difference?—No doubt the daily differences would run the same way in the two cases, but whether the mean temperatures would be absolutely the same I am not prepared to say.

14,067. (*Mr. Samuelson.*) You have drawn a distinction between physical and climatic meteorology, and you have stated that you think that the Meteorological Office would do best to occupy itself chiefly with physical meteorology. Before this matter was taken in hand by the Meteorological Office it was in the hands, was it not, of the Meteorological Department of the Board of Trade?—Yes.

14,068. What was the nature of the observations made by that Department; was it chiefly in the direction of physical or of climatic meteorology?—The observations had chiefly reference to the weather, and in that way I think they were observations more having reference to physical meteorology, that is, physical meteorology regarded from perhaps a practical point of view. Admiral FitzRoy had certain stations from which observations were telegraphed to him with the object of enabling him to predict as well as he could impending storms; and also he got the logs of vessels with a view to getting a knowledge of ocean meteorology—that is certainly a branch of physical meteorology.

14,069. When the functions of that department ceased, the Meteorological Committee was charged with the organisation of the Meteorological Office: was it intended that any change should take place as to the nature of the observations which were to be conducted by that Office, as compared with those previously conducted by the Meteorological Department of the Board of Trade?—It was intended to render the observations much more complete, and to put them on a much more scientific basis.

14,070. But still the character of those observations was to be chiefly that of physical meteorology?—Yes, I understand so. I do not know that the words physical meteorology were mentioned. I do not think that any distinction of that kind was made. It is only recently that an endeavour has been made to divide meteorology into those branches. It was a science quite in its infancy, and the division had hardly been thought of perhaps at that moment.

14,071. What were the observations that were intended to be undertaken in consideration of the grant of 10,000*l.* per annum by the Government?—They wished to have a complete scientific knowledge of the meteorology of the country.

14,072. (*Dr. Sharpey.*) Was not one object to extend the land observations as distinguished from marine observations?—That was one. Whatever the term used was, there is no question that at the moment when the new office was constituted it was physical meteorology that they contemplated. I do not fancy that Admiral FitzRoy's meteorology was of a climatic nature at all; it was really an attempt to put meteorology upon a physical basis. He got the statistics of the ocean, that was one point, and another point was to see what the atmospheric currents were, more especially with the view, whenever those atmospheric currents were violent, of giving warning to the different ports. No doubt it had a practical bearing, but at the same time I conceive that it was a practical application of physical meteorology.

14,073. (*Mr. Samuelson.*) How far do you think that the intentions which were entertained at the time of the establishment of the Meteorological Office have been carried out practically by the office?—It appears to me that they are putting the storm warnings upon a very good footing, so far as I can judge from the figures, and I have no other means of judging; but it appears to me that they are gradually working it out very well.

14,074. And in addition to that they are doing other work which was not contemplated at the time, because the utility of it was hardly sufficiently appreciated?—I am not sure whether they have undertaken anything very recently, but as long as I was there they did not undertake any new work except what was laid down in the first general programme.

14,075. Certain work has I think been done by Mr. Glaisher?—Yes.

14,076. What is the character of that work; is it parallel to the work done by the Meteorological Office, or is it distinct from it?—I think it is distinct from it, it being more of a climatic nature. I should say that Mr. Glaisher has shown certainly very considerable energy in pushing meteorological matters before this country. He has created a large amount of interest in meteorology.

14,077. Are you aware of some correspondence that passed between the Registrar General and the Treasury on the subject of the grant which Mr. Glaisher has hitherto received, in order to enable him to conduct certain observations?—Yes, I have been led to understand that there has been such a correspondence.

14,078. And the result of that correspondence is, that the grant to Mr. Glaisher is intended to be limited by the Treasury to the year ending the 31st March 1874, so far as the correspondence goes?—Yes, I think that the subject being in connection with the death rate is not a subject which ought to be undertaken by the Meteorological Office. So far as my opinion stands, I think that the Meteorological Office ought to limit itself entirely to physical meteorology.

14,079. If you will refer to a letter which forms a part of the correspondence between Mr. Scott, the Director of the Meteorological Office, and the Registrar General, you will find that he states that the Committee having a staff competent to discuss the returns would be most happy to meet the wishes of the Treasury by supplying such returns (namely the returns which have hitherto been supplied by Mr. Glaisher) free of charge?—I still think that it is highly inexpedient that the Meteorological Office should undertake anything but physical meteorology.

14,080. Assuming that the Office is in possession of information for the purposes of physical meteorology, would you still consider it undesirable that they should communicate it to the Registrar General for the purposes which it would serve with him?—I think that is a detail which might be left to the Registrar General. The Registrar General, I consider, so far as that is concerned, is the responsible officer. Provided that my view were followed I should consider that the responsibility of the Meteorological Office was entirely with reference to putting physical meteorology upon a proper footing. Under these circumstances, even though there might be some additional expense incurred, it appears to me that it would be undesirable that they should have anything to do with the other branch. The publications are regularly made and I

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

suppose that these publications would be at the service of the Registrar General as much as they would be at the service of any other meteorologist. If the Meteorological Office make these publications regularly, the Registrar General has access to such publications.

14,081. If the publications of the Meteorological Office furnish the Registrar General with the same information as is now furnished by Mr. Glaisher, you think that there would be no occasion to pay for Mr. Glaisher's observations in future?—If they do so; if these publications absolutely give the same information that Mr. Glaisher gives, then surely the Registrar General can get it in that way; but I cannot conceive that they do. Physical meteorology requires one condition of things, and climatic meteorology another, and I cannot conceive that the same information would serve both purposes.

14,082. You cannot conceive that in the course of the investigations which are required for physical meteorology observations could be obtained which should serve the purposes of the Registrar General?—I think that it is highly inexpedient to mix the two objects. If you were to take an observation partly with reference to climatic but partly with reference to physical meteorology, the chances are that you damage the excellence of the observation. Something must be uppermost in the mind in fixing on any given set of observations, and you cannot take an observation the main point of which is to find the physical atmospheric condition of a place, and at the same time to find the peculiarities of the place as regards the death rate or some human interest.

14,083. Could you make that more plain by examples?—One example is this; for instance, the Registrar General would wish observations in certain districts where it would be of no importance to the Meteorological Office to have them. The Meteorological Office dealing very much at the present moment with the weather and the winds, and especially the high winds that come into this country, their stations are more particularly stations upon the coast; but the Registrar General, dealing with the general climate of the country throughout, would require to have a great number of stations inland. There evidently the conditions that satisfy the one are very different from those which satisfy the other.

14,084. In the two maps that are before the Committee, the map containing the blue dots marks the stations of the Meteorological Office, and the map containing the yellow dots marks those stations which are at the disposal of the Registrar-General through Mr. Glaisher. Would you have the kindness to compare those two maps and state whether, in your opinion, the stations already established by the Meteorological Office would be likely to answer the purposes of the Registrar General?—I do not exactly see what is meant by the stations of the Meteorological Office inside the coast. There is one, for instance, at Moorside, one at Sheffield, one at Nottingham, and one at Cambridge, and I see there is one at Parsonstown, where Lord Rosse lives, and at Parsonstown no doubt they could get very good observations. Those are, I presume, stations that they have got recently with the object of finding out the meteorology of the country more perfectly.

14,085. Do you think, from your point of view as to their functions, it is objectionable that they should concern themselves with observations at those stations?—No. I do not think it is, but I think all the observations taken by them should have reference to physical meteorology. You cannot do the two things. With reference to the considerations of climate and death rate, it is just possible that there might be much light thrown upon the subject by observations in the locality and under circumstances which would be absolutely of no use to the Meteorological Office considered as an office for ascertaining the physical meteorology of the country.

14,086. You would, in the first instance, leave it to the Registrar General to determine as to what are the best means of obtaining the information?—Certainly.

14,087. And if he should require information of a different nature from that which the Meteorological Office is enabled to supply from information obtained for its purposes, you would then consider it inexpedient that they should take any special steps to enlarge their inquiry in the direction required by the Registrar General?—Yes, certainly; therefore I should limit their aid to the publication of observations, bearing in mind that a perfect separation ought to be kept between the two branches. It would be inexpedient for the one office to go and supplement the work of the other in any way except by its publications. When once the publications are given, the Registrar General may make what use he likes of them, but I think it is inexpedient that the Meteorological Office should in any way undertake work that has not reference to physical meteorology.

14,088. You are aware, are you not, that the grant which Mr. Glaisher has received is a very small one?—Yes; I think it is exceedingly small.

14,089. And, consequently, it could only represent an amount of clerical work which is not very large?—Just so. If the Registrar General thinks that that work should be increased and the grant supplemented, that is a question for him to consider.

14,090. If, on the other hand, the Director of the Meteorological Office should consider that the work required by the Registrar General is so small that it could easily be done in his office, would that weigh with you at all as to the decision you would come to with reference to the office doing it or not?—I do not think it would; I think it highly inexpedient. It appears to me that the great danger is of mixing up in the minds of the Meteorological Office or Meteorological Committee these two points, which ought to be kept perfectly distinct, and it would ultimately be a true saving of money, because it would tend to the excellence of the observations, that the two branches should be considered as absolutely distinct. If we wish to know the physics of a place we must certainly make our observations solely with regard to that, and also if we wish to know the death rate of a place we must make our observations with sole reference to that point.

14,091. Are there any Government departments, so far as you are aware, in other countries, corresponding to the Meteorological Office?—Yes; in different countries of Europe and in America there are corresponding departments.

14,092. Do you know what is the constitution of any of those departments?—I have not got accurate information on this point, but, so far as I can make out, their great object is physical meteorology, and especially with reference to storms. That is one of their great objects, to ascertain the progress of the weather or of storms, as they affect the atmosphere of our earth. That appears to me to be the great object with which all those institutions were founded. Whether all of them have recognised the distinction between those two branches of meteorology I am not prepared to say. It appears to me that the late Mons. Quételet of Brussels did not. He devoted a great deal of attention to climatic and statistical meteorology.

14,093. You believe that when this board was established in England, it was not intended that it should devote itself to such observations?—No, I think not. I am not sure that those words were used, for I am not sure that the distinction between the different branches of meteorology, or rather of two sciences both requiring observations of the same instruments, was so well understood as now.

14,094. (*Professor Smith.*) Will you look at the First Report of the Meteorological Office, at page 6, where they describe their functions under three heads very concisely, and will you read them?—"The "functions of the present Committee are divided into "three great branches. I. Ocean Meteorology.—The "object of this branch is to deduce the meteorology "of all parts of the ocean from observations made by "ships. The surface of the ocean is conventionally

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

"portioned off by lines of latitude and longitude into "a vast number of sections, and the meteorology of "each section is discussed as though it were an "independent district. The issue of instruments to "ships is also undertaken by this branch. II. Telegraphic Weather Information.—This branch of the "functions of the Committee comes most prominently "before the public, but it must not therefore be "assumed that it is the most useful or important "part of their work. III. Land Meteorology of the "British Isles.—The new feature of this branch "consists in the establishment of seven land observatories provided with self-recording instruments. "Its object is two-fold, first to give accurate data for "a discussion of the law of storms and weather "changes, and secondly, to ascertain meteorological "constants, thereby performing with great precision "for the land stations that which is accomplished "with moderate precision by Branch I. for the entire "ocean." It appears to me that this has no reference to such points as death rate at all, but simply reference to physical meteorology.

14,095. According to the views which you entertain, is there any part of the functions which are described in the First Report which you think ought to be abandoned by the Meteorological Office?—No, I do not think that any part of this work should be abandoned.

14,096. Does it seem to you to represent pretty fairly what you understand by physical meteorology?—I think so; I think it is a very good statement indeed.

14,097. Do you consider it fairly describes what ought to be done?—As far as physical meteorology is concerned, I think, very likely, that something more should be done. I do not know that electricity is mentioned here, but I think they intended to do it themselves. I know that they had an idea of determining fairly what the physics of our atmosphere really were.

14,098. (*Mr. Samuelson.*) There is no analogy between what is required by the Registrar General and that which was laid down by the Board itself, as being the work which they were to perform?—No, I do not think there is any analogy. Ultimately, in the progress of that science which the Registrar General represents, it might be desirable to make chemical observations in drains, and to put thermometers in different localities where there is bad air, but that is not at all information that would be of any use for physical meteorology.

14,099. (*Chairman.*) Surely the information which the Registrar General needs comes properly under the head of "Land Meteorology of the British Isles," does it not?—I think that is a question of wording. I think the information that he needs is connected with the subject, but it is the subject viewed from a perfectly different point of view.

14,100. (*Mr. Samuelson.*) The land meteorology in the words of that report is limited, is it not, to seven stations?—Yes, it is.

14,101. And on the map which represents the work of the Meteorological Department there is, at any rate, a number of stations considerably in excess of seven?—Yes. Still, if those stations are put there in order to obtain a better account of the physical meteorology of the British Isles, although it seems to be in addition to what they considered their own functions, I should not object to that. I think that what they ought to do is to obtain a perfectly complete account of the physical meteorology of the British Isles, and, as far as possible, of the ocean; and I think they should confine themselves to that.

14,102. With regard to the organization of the Office, you have stated that you would prefer the appointment of a Meteorologist Royal to an unpaid Committee?—Yes, I think so, only you are of course aware that that Committee has an officer who bears the title of Director of the Office.

14,103. Do you consider that there is any analogy between the responsibilities attaching to that office and those which you would wish to attach to the head of the Meteorological Department?—There is a very strong analogy as far as their work is concerned, but I think there is no analogy as far as the responsibility is concerned. A Meteorologist Royal would be responsible to the Government in the same way as Sir George Airy is responsible. From his internal knowledge of the subject, he would initiate and work out the subject without being under the orders of an unpaid Committee. What the Director of the Meteorological Office has to do, is simply to carry out in an intelligent manner, no doubt, but still to carry out, the orders of the Committee.

14,104. You would consider the term "Director" as rather calculated to mislead?—I think it is calculated to mislead in the present instance. The subjects which the Director has to study are subjects given him by the Meteorological Committee, and his duty of course is to study them, and to advance those subjects in the most intelligent manner. Suppose that the Director thought that the subjects should be studied in quite a different way from the way in which the Meteorological Committee study them, then, as I understand, he could not direct, he would have no voice in the question. He simply has to carry out as intelligently as possible the orders of the Meteorological Committee.

14,105. That is to say, instead of being the Director, he is a secretary or an executive officer of the Department?—Yes, an intelligent executive officer.

14,106. Was that in accordance with the intentions of the Meteorological Committee when the office was organized?—Yes, no doubt.

14,107. His functions are not anything like those, for instance, of the Director of the Geological Survey or of the Topographical Survey?—That officer, I presume, is responsible to the Government, and he does what he considers best. I think that in the annual reports published by the Meteorological Committee, the Committee take the responsibility upon themselves.

14,108. (*Professor Smith.*) If you look at the last Report, they state, "for the administration of which "they are wholly responsible, and over which they "have the entire control?"—Just so.

14,109. (*Mr. Samuelson.*) Neither when the appointment of the Director was first contemplated, nor at the present moment are his functions at all parallel to those of the Director of the Geological or the Topographical Survey?—No.

14,110. (*Chairman.*) Do you think that the sum allotted to the office is sufficient to carry out all the functions that the Committee describe at page 6 of the First Report?—I think it is just possible that they might require a small addition, but if not quite sufficient it is very nearly so. I am not prepared to say absolutely whether, if they were to carry out atmospheric electricity, and discuss the results more fully than they do at the present moment, it would be sufficient. Some addition might be made, but I do not think that the addition would be anything very large.

14,111. I see in the Report of the Committee, at page 40, after mentioning the ocean statistics, they say that the expenditure under that head, amounting to 3,200*l.*, ought to terminate in about 15 years, do you agree in that opinion?—It appears to me that it does not contemplate the fact that there are very few observations in certain localities of the ocean. If we are ever to come to a thorough knowledge of meteorology, it is essential that we should obtain much more information about the oceanic regions than we do from the logs of vessels which pursue a given route in the ocean. We must make an effort to employ our navy in such a manner as to get information with regard to the less frequented oceanic regions.

14,112. You do not think that that sum will become disposable in 15 years?—I think that some of it might possibly become disposable, but that is a point upon which I am not sure that I can give any definite information.

14,113. (*Mr. Samuelson.*) You have stated that you think that there should be institutions for special

B. Stewart, Esq., LL.D., F.R.S.

23 April 1874.

solar observations, and that they should not be under the direction of the individual or the body directing the meteorological observations?—I think that although, no doubt, solar observations are connected with meteorology, the two things are sufficiently distinct. If there were a re-organisation of the science of the kingdom, with something like a Ministry or Subministry for Science, in that case such an official would take charge of all the various Departments; and I think that a Solar Observatory is a thing in many points very distinct from the Meteorological Office, just as it is from Astronomy. On the one side it has astronomical bearings, and on the other it has meteorological bearings, at least I am disposed to think that it has.

14,114. But do you think there would be work enough there to engage a special department and under special direction?—I think so; not, perhaps, a large department, but certainly there is quite enough to engage a special department.

The witness withdrew.

Adjourned to Tuesday next at 12 o'clock.

No. 6, Old Palace Yard, Westminster, Tuesday, 28th April 1874.

PRESENT:

HIS GRACE THE DUKE OF DEVONSHIRE, K.G., IN THE CHAIR.

The Most Hon. THE MARQUESS OF LANSDOWNE.
BERNHARD SAMUELSON, Esq., M.P.
WILLIAM SHARPEY, Esq., M.D., F.R.S.
THOMAS HENRY HUXLEY, Esq., LL.D., Sec. R.S.
HENRY JOHN STEPHEN SMITH, Esq., MA., LL.D., F.R.S.

The Rev. ROBERT MAIN, M.A., F.R.S., examined.

Rev. R. Main, M.A., F.R.S.

28 April 1874.

14,115. (*Chairman.*) I believe you are the Radcliffe Observer, and have charge of the Radcliffe Observatory?—Yes.

14,116. Has not the system of meteorological observations been for some years in operation in that observatory?—We can give continuous observations from the year 1811, that is to say, the ordinary observations; but the photographic observations commenced with the year 1854. There has been a continuous series of photographic observations from 1854, and of ordinary observations, three per day, commencing with the year 1811.

14,117. The Commissioners would be much obliged to you to state to them the principal results of the observations at your Observatory?—We have attended, I may say in the first place, accurately to everything that relates to climatic meteorology; that is to say, we have given every element for the determination of the climate of Oxford, including daily, mean monthly, and mean yearly values of all the meteorological elements. We have also computed accurately the diurnal variations of all the meteorological elements; that is, of the results for the barometer, the thermometer, the hygrometer, the pressure of dry air, and the wind both in velocity and direction. These are all represented in as scientific a shape as they can be, by means of Bessel's Interpolation Formula, which is applied to all the results, not only to the wind, but, commencing with the barometer, to all the rest. The constants for the terms depending upon the sine of the sun's hour angle and its multiples, are given for all these and for the mean monthly results of the wind, which, as is well known, has been formerly a subject of very great trouble to ordinary meteorologists, on account of their never having undertaken the labour of computing by a strictly mechanical method. What is called Lambert's Formula was applied; but that did not help much. It was, in the first place, only an approximate formula, and, until I took up the subject on coming to Oxford I believe that the directions and velocities were never combined; that is, that the pressure of the air was always left out of the account, and consequently when we wished to get the mean direction of the wind the very light air in a certain direction counted just as much as a storm in that direction. I have by ordinary mechanics computed the monthly and yearly resultants of the wind for a series of years commencing with 1859, and this has led to some of our most curious and interesting results. I have copied some tables contained in the Radcliffe Observations which will enable the Commissioners to see what I mean. The first is as follows:—

YEARLY MEAN DIURNAL CHANGE of the VELOCITY and DIRECTION of the WIND.

The formula in each case gives the Bihorary Horizontal Velocity at any hour $\frac{x}{15}$ reckoned from noon, in terms of x and the Mean Daily Bihorary Velocity.

Year.	miles.
1859 - -	$20{\cdot}8 + 3{\cdot}81 \sin (x + 87^\circ) + 1{\cdot}35 \sin (2x + 105^\circ)$
1860 - -	$21{\cdot}5 + 3{\cdot}75 \sin (x + 82) + 1{\cdot}08 \sin (2x + 117)$
1861 - -	$19{\cdot}6 + 3{\cdot}25 \sin (x + 84) + 1{\cdot}13 \sin (2x + 89)$
1862 - -	$20{\cdot}8 + 3{\cdot}37 \sin (x + 91) + 1{\cdot}09 \sin (2x + 115)$
1863 - -	$21{\cdot}0 + 3{\cdot}45 \sin (x + 85) + 1{\cdot}20 \sin (2x + 91)$
1864 - -	$19{\cdot}5 + 3{\cdot}58 \sin (x + 75) + 1{\cdot}11 \sin (2x + 93)$
1865 - -	$18{\cdot}7 + 3{\cdot}25 \sin (x + 87) + 0{\cdot}98 \sin (2x + 96)$
1866 - -	$22{\cdot}3 + 3{\cdot}83 \sin (x + 75) + 1{\cdot}07 \sin (2x + 106)$
1867 - -	$21{\cdot}1 + 3{\cdot}31 \sin (x + 82) + 1{\cdot}11 \sin (2x + 100)$
1868 - -	$21{\cdot}6 + 3{\cdot}87 \sin (x + 80) + 1{\cdot}34 \sin (2x + 107)$
1869 - -	$21{\cdot}4 + 3{\cdot}20 \sin (x + 83) + 1{\cdot}33 \sin (2x + 103)$
1870 - -	$19{\cdot}5 + 3{\cdot}36 \sin (x + 84) + 0{\cdot}81 \sin (2x + 87)$
1871 - -	$18{\cdot}2 + 3{\cdot}45 \sin (x + 83) + 1{\cdot}24 \sin (2x + 97)$
1872 - -	$19{\cdot}6 + 2{\cdot}91 \sin (x + 79) + 1{\cdot}15 \sin (2x + 92)$
1873 - -	$19{\cdot}0 + 3{\cdot}56 \sin (x + 84) + 1{\cdot}12 \sin (2x + 89)$

Rev. R. Main, M.A., F.R.S.

28 April 1874.

This table relates to the diurnal change in the observed horizontal velocity of the wind, and a mere glance will show how very constant this variation is for each year, the constants of the first and second terms, depending on the sun's hour angle, are not exactly invariable, because they depend upon the actual velocity of the wind; but they are very nearly so, and the mean of a long series of years would give almost as correct and unchangeable a result as some of the constants determined in astronomy. I do not think that there is any one element in meteorology up to this time discovered which is so constant as this mean daily change for Oxford in the direction and velocity of the wind. If the Commission will allow me, I will hand in this second table:—

Mean Horary Directions and Velocities.

The following Yearly Mean Velocities and Directions at every two hours of the day are derived from Seven Years' Observations (1859 to 1865).

h.	Mean Direction.	Mean Velocity (Bihorary).
	′	miles.
0	S. 47·41 W.	15·58
2	49·46	15·35
4	47·52	13·83
6	46·00	12·08
8	41·33	12·02
10	40·27	11·74
12	41·43	11·84
14	42·29	11·58
16	41·57	11·55
18	44·10	11·64
20	44·50	13·32
22	47·43	14·78

This second table gives the results of observations for seven years, and, of course, with actual numbers for the bi-hourly intervals of the day. The change in the direction of the wind and in the velocity during the time that the sun is above the horizon, is very marked indeed. During the time he is below the horizon the direction is sensibly constant as is also the velocity. I will now hand in another table which gives results of some interest and importance:—

Year.	Yearly Resultant Direction of Wind.	Yearly Mean Hourly Horizontal Velocity.	Mean Yearly Temperature.	Yearly Fall of Rain.	—
	°	miles.	°	in.	
1859	S. 53½ W.	10·4	50·1	27·717	
1860	70½	10·8	46·8	31·006	Max. of frequency of solar spots.
1861	51	9·8	49·0	23·403	
1862	51½	10·4	49·5	27·417	
1863	41	10·5	49·9	22·365	
1864	20	9·8	48·5	18·255	
1865	16	9·4	50·0	28·717	
1866	12½	11·2	50·1	30·624	Min. of frequency „ „
1867	24	10·6	48·9	27·125	
1868	38	10·8	51·4	25·972	
1869	80	10·7	50·2	26·474	
1870	93	9·7	49·3	17·564	
1871	26½	9·1	49·2	21·137	
1872	63	9·8	50·1	29·477	
1873	59	9·5	49·1	23·178	

This third table is chiefly valuable as showing the apparent effect of the sun's spots period on the yearly mean direction of the wind. The year 1860 was the maximum of solar spot frequency, and the wind then is in a very marked way in an extreme westerly direction. It then goes backwards with tolerable uniformity, excepting in 1861 and 1862 (which were by some accident very nearly equal), until the year 1866, when it became nearly south, and that was the year of minimum frequency. Since the year 1871 we have got into another cycle, and it is evidently on the whole going back toward the south, so that we shall soon, in a few years, have completed a second cycle, leaving no doubt of the actual fact.

14,117*a*. The year 1871 seems rather an exception to the general law?—Yes. I was puzzled myself with that, but I believe that there was really a very marked southerly direction of the wind in that year, or rather that it was mixed up very much with east winds. I have been looking through the monthly records of the Meteorological Journal for that year, and I am sure that the mean monthly and yearly results computed mechanically for 1871 are borne out by the data of the daily results (in which the directions of the wind are estimated by the eye), and it must for the present remain as a puzzle and as an exception to the general law. We have certainly passed the maximum now, and are fast going towards the minimum. There are very few spots now. In the column of rain in the table (it may be accidental, or it may have something to do with the cycle) the year of maximum frequency and the year of minimum frequency has each a large quantity of rain. In the two years 1860 and 1866 the rainfall is greater than in any other years, but at the time when we ought to have got to the maximum again we get a very small quantity. We have absolute drought for two years.

I can also give a table of the results for the months of April and May of some curves of daily mean temperature, which I found occasion to draw for a number of years from 1859 to 1871, and I think they threw considerable light on those singular interruptions of temperature which we get both in April and in May:—

Rev. R. Main, M.A., F.R.S.

April 1874.

Year.	Month.	Lowest Mean Daily Temperature.	Day.	Range of Disturbance.	Month.	Lowest Mean Daily Temperature.	Day.	Range of Disturbance.
		°	th	d. d.		°	nd	d. d.
1859	April	37	16	7 to 25	May	43½	2	$\overline{28}$ to 7
1860	„	36½	10 & 14	7 to 15	„	48½ & 47	3 & 5	2 to 7
1861	„	39½	9 to 27 (several)	9 to 27	„	39½ & 42	$\overline{27}$* & 4	$\overline{25}$ to 2 & 2 to 6
1862	„	35½	11	5 to 20	„	48½	2	1 to 5
1863	„	42	7	5 to 8	„	39½	0	$\overline{26}$ to 3
1864	„	36	5	3 to 10 (for 14th)	„	44½	$\overline{28}$	$\overline{20}$ to 2
1865	„	42 & 47	1 & 14	11 to 17	„	45	$\overline{30}$	$\overline{27}$ to 5
1866	„	40 & 43	4 & 9	2 to 6	„	38½	1	$\overline{27}$ to 8
1857	„	44	11	6 to 13	„	48½	1	$\overline{29}$ to 6
1868	„	37	12	5 to 10	„	45 & 57	$\overline{27}$ & 5	$\overline{21}$ to 8
1869	„	40	3	2 to 7	„	46½	1	$\overline{27}$ to 2
1870	„	41	4	2 to 7	„	41	2	$\overline{30}$ to 5
1871	„	39	6	4 to 12	„	47 & 46	$\overline{30}$ & 4.	$\overline{26}$ to 2 & 2 to 6

* $\overline{27}$ denotes April 27.

In the April of this year 1874 there has been a cold period, though not in a very marked way. Before this warm weather set in, there was cold stormy weather, not so cold as it is in some years, but still cold enough to show that we have passed through the time of ordinary depression of temperature. This disturbance occurs frequently towards the middle of the month, but the actual time of minimum temperature is not quite so well defined as the one in May. Some of the disturbances are, as you would expect, greater than those in May, but with respect to the time not quite so well marked, although we should probably not be very far wrong if we assumed that before the middle of April we might almost with certainty predict something of the kind. In May almost the very day of the minimum temperature is marked. You will observe that 5 is the greatest number that we have in the column headed "Day," and, in fact, counting from the 1st of May on either side we have only deviations of two or three days in all the table, so that we may almost infallibly predict a cold period having its minimum temperature on some day a little before or a little after the 1st of May. And that leads us immediately to speculate on the cause of this disturbance, which has been a subject of a great deal of thought to myself, and I am convinced that it arises from disturbances in the Atlantic and the North Sea, as, in very many cases, the storms in England do. The glacier and field ice probably about this time begins to break up and get detached in the Polar seas, and large masses of it no doubt are brought down, and I should think, as the operations of nature on a large scale are generally tolerably uniform, that this would occur pretty nearly at the same time every year, and would give rise to this apparent periodicity of disturbance. It is therefore evidently necessary that if we wish to study our climate accurately for the spring months we must have more information with respect to the temperature of the currents of the north or frozen sea at that season. Information is very desirable from stations in Greenland, Iceland, and Spitzbergen, whenever we can get it, and from the observations of mariners who have been employed in those seas. I think it is a matter of very great importance to our climate that the northern seas should be studied very much more than they are now. When I asked some time ago the hydrographer on this very subject, (which interested me as it was new to me at the time,) what information I could get with respect to the changing currents, and the quantity of ice brought down off the coasts of Greenland and Spitzbergen, he gave me little hope of getting any adequate information from anything which exists at present. The Norwegians are doing a great deal, and the Swedes also, and it is quite right that the British Government should take part in any systematic labour which might be agreed upon for getting a better knowledge, both of the temperature of the currents and of the changes in them, and also on the fall of glacier ice. With respect to our own observations I think that that is almost all that I need say. I have sent a copy of one of our little books for the information of the Commission, to show the form in which everything is done, and that form, as I have stated, I have never had occasion to alter since I came to Oxford. I took some pains in compiling it so as to retain simply what was useful, and I have scarcely had occasion since to make any alteration in it.

14,118. Are you in the habit of corresponding in any way with the Meteorological Committee?—Oxford is made one of the stations, and we send every morning a telegram of the weather, which is included in the daily bulletin, but otherwise the actual correspondence, as it merely relates to this daily work, is carried on between Mr. Scott and my first assistant, Mr. Lucas. I occasionally receive a letter from Mr. Scott on some subject or other.

14,119. Then your observations at the Observatory are totally independent of any proceedings of the Committee?—Yes, and for some time we were not included in the list of stations, but within the last two or three years it was thought desirable to have, in addition to coast stations, some inland stations, and Oxford, as having photographic instruments, was selected for one, and Cambridge was selected for another, as likely to carry on a regular series of observations. Cambridge, I believe, has not photographic instruments, but still, as it is a fixed Observatory with a responsible chief, it was thought better, I presume, to include Cambridge.

14,120. Do you consider, as a general principle, that meteorological observations can be with advantage carried on at astronomical observatories?—Better than anywhere else, because there is a well organised staff, who are generally under the command of a highly scientific man, who can take advantage of the progress of science and modify his methods as he thinks fit, and can insure things being done in the best possible way and with regularity. The work of private observers, of course, is very good, but there is no control over them. A series may be intermitted at any time without any one being blamed.

14,121. A great deal of work of that kind can be carried on without interfering in any objectionable manner with the Astronomical Observatories?—It can in general; but I cannot say that with respect to the reductions. I have always found my work a very heavy load; the computations are exceedingly heavy which I have been explaining just now; for instance, our yearly record for the wind would employ one man a fortnight to reduce. There are 144 mechanical equations, there being 12 bi-hourly results for each of the 12 months in the year, and each of these 144 computations involves a good deal of labour.

14,122. Is your staff larger than it otherwise would have been in consequence of your undertaking this class of observations?—No. I am of opinion that our staff till recently was too low for the work that is done, and, if I did not take a very great share of personal labour myself, it could not be done; and it has been a subject of regret to astronomers and others that I should be obliged to take so much work upon myself. In 1872 relief was afforded by the Trustees, with their usual liberality, by the addition of another computer to the staff, and this has been of very great service to the establishment. I would not recommend any new establishment to undertake the same amount of work with the same staff. I can do it, because I had a good training at Greenwich, and of course had become skilful in finding out every possible means of shortening the labour of computation and of organising the work. Our people have got into the way of working hard, but still there is no doubt that it is hard work. The astronomical computations and the meteorological together form a burden which few other observatories would willingly undertake. It was proposed, when I came to the Observatory, by the Trustees, that the meteorological observations should be given up, but I found almost as soon as I got to Oxford that the objections were so great to their being given up that I could scarcely resist them, and I therefore determined to attempt to continue them.

14,123. Do you know how far meteorological observations are carried on at other observatories, either in this country or on the continent?—They are carried on with regularity at Greenwich, but they have not been reduced till recently. The Astronomer Royal has lately taken them up, and the back observations are being reduced from 1848 to 1868. He is bringing his powerful mind to bear upon the subject, and I have no doubt that we shall get some very interesting results from them; but at the present time the reductions are not published. The observations taken at Greenwich, when they are reduced, will be very valuable; they are taken with photographic instruments, as ours are, only of a different construction.

14,124. Is anything of the kind done at any of the principal observatories on the continent?—Perhaps the most remarkable is that conducted by Professor Wild in St. Petersburg. The physical observatory, of which he is the director, is perhaps the best model possible of a great central observatory for a country such as Russia, which has outlying stations at such immense distances. At every station where there is an observatory the meteorological results are required to be reduced and to be sent in to the central observatory to Mr. Wild, and they are published annually, and there is a great mass of matter given, but I must say that at the present time it is in rather a repulsive shape. The observations are thoroughly undiscussed, and it will involve an immense amount of labour some day to do it.

14,125. Do those observations of yours involve any costly apparatus?—No, I do not think so. The work of one assistant is quite as much as in my small staff I can consider as appropriated to that work, and 20*l.* a year is spent for chemicals. If then I were to estimate the total expense of the meteorological department at 140*l.* a year, I think I should rather overstate than understate it. The expense is not more to the Radcliffe Trustees than that sum, including chemicals. It is not costly at all when the apparatus is once set up. The apparatus which we have at Oxford is that which was planned by Sir Francis Ronalds. There were two arrangements of photographic instruments originally invented, one by Sir Francis Ronalds, in which a piece of paper, developed in a plane surface, is moved on by clockwork in a direction at right angles to the ray of light, and another, invented by Charles Brooke, Esq., in which the paper is laid round circular glass cylinders. The latter, invented by Mr. Brooke, is the one used at Greenwich, but I consider that ours is the simplest, and involves the least labour, the paper requiring to be changed only every 48 hours, and I should think that the whole interruption to the whole morning's work is certainly not two hours. It does not interfere with our astronomy more than that. The sending of telegrams is a little addition to our labour, because, when astronomical observations are taken at night, imposing upon the observer the duty sometimes of staying up tolerably late, it is rather a hard thing that he should be obliged to turn out between 7 or 8 in the morning to prepare these telegrams. But Mr. Lucas, with his usual willingness, has undertaken it, and it goes on very well. I left it to his free choice, and if he had objected, I should have declined; but he did not object, and the thing goes on very well, though I could scarcely impose it on another assistant, with all the other duties which he has to discharge. Occasionally requests are made for additions to the observations arranged for originally, and it is necessary sometimes to refuse compliance.

14,126. Are you speaking now of the Meteorological Committee?—Mr. Scott, with the best intentions of course, wishes sometimes, for the sake of uniformity, to introduce some things which are apparently very proper and very right, but when one has been worked to the last ounce, it becomes a very serious matter to undertake anything else, and I have been obliged to tell him once or twice that we have been doing all that is possible as it is, in sending up the telegrams to the office.

14,127. (*Professor Smith.*) Do the Meteorological Committee pay in any manner the assistant at the Radcliffe Observatory?—They pay a trifling sum of 5*s.* a week, but a part of that is expended, because a boy has to be found to carry the telegrams, so that it is not a very large pay.

14,128. Is that the way in which the other meteorological stations are paid?—I do not know. Mr. Scott explained to me at first that that was all that they could afford to pay.

14,129. (*Chairman.*) Have you paid attention to the work which is carried on under the direction of the Meteorological Committee?—Yes, I have studied their synoptic charts very attentively every day, and I consider them very useful indeed. I can trace very rapidly indeed the connexion between the different elements that form the weather in those charts, and sometimes almost predict as they can themselves for the next day, but I suppose that other people see as well as I do that we want something on a very much more extensive scale. We want, in fact, international meteorology. We have in these synoptic charts, the coast of Norway, all the way up the coasts of England and Scotland, and the coast of Ireland, and several stations on the coast of France, including Toulon on the Mediterranean; also Corunna on the coast of Spain. There are also some foreign inland stations, as Paris, Charleville, Lyons, and Brussels; but the area is frequently too limited to give us the whole of a storm or to give us its history. I have sometimes found, especially in the case of a large anti-cyclone, that the space is not large enough to give the whole of the phenomena. For instance, we have been having, in the last month or two, some very remarkable specimens of anti-cyclones. I should explain that these are just the reverse of cyclones. A cyclone is a revolving

Rev. R. Main, M.A., F.R.S.

28 April 1874.

mass of air in which the air turns from right to left in the northern hemisphere, and an anti-cyclone is on the contrary one which turns from left to right. And they differ, of course, in their physical properties; in one the centre is a centre of depression, and in the other it is a centre of greatest pressure. The theory of anti-cyclones, I consider, with respect to international meteorology, to be one of the most important possible, because it is well known that outside the area of the anti-cyclone there is a series of small cyclones, that is to say, a series of disturbances, and many of the storms originate in that way outside the area of greatest pressure. The four charts which are given are:—1. A chart of the isobars or lines of equal pressure; 2. A chart of the corresponding winds, which can almost be drawn by any person, without observation of the winds, with considerable accuracy, for the law of pressure regulates the direction of the winds; 3. A chart of the temperature; and 4. A chart of the general character of the weather with respect to cloud rain, &c. And, excepting that it would be desirable to extend them by international relations, and to have something on a much larger scale, which of course would involve very considerable difficulties in arrangement with other Governments, I do not know anything to object to these synoptic charts. They are done very well indeed, and they are exceedingly useful. I have no doubt that they answer pretty nearly every purpose on ordinary occasions for the British Isles, even for forecasts of the weather. One instance I remember in which I found that the French bulletin assisted me in the history of a storm, although it does not take in many more stations than ours does. Ours goes up to Haparanda at the top of the Gulf of Bothnia, and the French does likewise, but the French have some inland stations that we have not. They have Berlin and Madrid; and in one or two cases I have found it very important indeed that we should know what is going on in the interior of the great European continent. There is also another tract of country in which the Russians will ultimately assist us very much in meteorology as affecting our own climate, and that is Central Asia. During the winter the pressure is piled up over Central Asia; it is intensely cold, and there is invariably high pressure, whereas on the contrary the pressure upon the sea is very much smaller. But towards spring an equilibrium takes place; the pressure over the land diminishes, as you might naturally expect, when the earth becomes warm, and increases, as the summer goes on, over the Atlantic. The study of the whole of this phenomenon in a systematic way would be, I have no doubt, with respect to our climate, very useful indeed. We should be able to know when the equilibrium is restored, and what the excess of pressure is over the sea in summer, and what the excess of pressure is over the land in winter. But as the Russians have the Caucasus and the whole of Siberia, and are getting down towards Afghanistan, I have no doubt that they will do what they have done in their other territories, namely, institute meteorological observatories, and that we shall get a very great amount of information ultimately about these territories.

14,130. Is there, to a certain extent, co-operation at present between the different Governments with respect to Meteorology?—I do not think there is with respect to Governments. All that has been done is to have yearly conferences, which is a recent thing. The two conferences, whose results are published, are those of Leipzig and Vienna. I suppose it is intended that these shall be continued frequently in the capital of one country or another, and it is with the concurrence of the Governments, but I do not think that the individual Governments take any responsibility in the matter. I remember that General Myer, who attended on behalf of the United States at the Vienna Conference, said expressly that he could not pledge his Government to any thing.* He however considered it desirable that means should be taken to have simultaneous observations made at least once a day at stations distributed over the whole northern hemisphere, and a resolution to that effect was unanimously adopted.

14,131. Do you think that something more is required?—Yes; I think that there should be an international co-operation, and that that should be done with some authority.

14,132. Are you prepared to make any recommendation as to how that object could be carried into effect?—I think, for instance, that the British Government, before the next conference, might request to be furnished with certain recommendations, and, if they would enter into a correspondence with other Governments before that time, I venture to say that an international committee or delegacy might very easily be formed which would facilitate matters. I have no doubt that there would be some difficulty at first, but I do not see anything insuperable in the way.

14,133. It would be difficult, would it not, for an international committee to meet frequently?—Yes.

14,134. How often do you think it would be necessary that they should meet?—I should remark, when I say an international committee, I mean persons authorised by their respective Governments to decide upon a system of co-operation;—for instance, a general interchange of these synoptic charts throughout Europe.

14,135. That is not the case at present, I believe?—No, it is not. The French publish their own separately. (*Bulletin International.*) And the Dutch, who are doing a great deal under M. Buys Ballot, have published their year book (*Jaarboek*, or *Annuaire*), but the results are not given daily. They have a system of telegraphy within Holland, but I do not think it exists beyond. Perhaps the very best specimen of this kind of work which exists at present, or at all events the best that I have seen, is "The daily bulletin of Weather Reports, "Signal Service, United States Army," taken three times in the day, for September 1872. It is probable that the volumes for the other months have appeared, but I have not seen them. I have had one or two of their reports, but this is the only one in which all the synoptic curves are given three times a day from the Pacific to the Atlantic, and as far north as they can go. It is an admirable volume for studying this kind of results, and I have no doubt that it would help us very much.

14,136. Is that kind of work undertaken by the State?—Yes; it is undertaken by the State, and it is done by the army. They spare no money where it is necessary. I think that our own military service might be made more effective than it is for our climatic meteorology if it were needed. Climatic meteorology has been, through other agencies, sufficiently attended to, as far as I know, in England, but still, for the training of officers and men, I think the first thing, where there is a permanent military station, should be the establishment of meteorological observations. It is so at the Camp at Aldershot;—observations are regularly published from the camp at Aldershot.

14,137. Is that under the direction of the Meteorological Committee?—I think not. I think it is quite separate.

14,138. Is there a separate vote for it in the Estimates?—I do not remember. I have only seen the observations which are included in the Registrar General's Quarterly Report. I suppose it began there with a view to a knowledge of the sanitary state of the camp, as part of the duties of the medical staff there.

14,139. With respect to what has been done under the direction of the Meteorological Committee, do you think that the work has been of much value?—Undoubtedly their forecasts of the weather are valuable and indispensable; and, as I said before, the synoptic curves are not only valuable now, but will be extremely valuable in the theory of Meteorology. And, as far as I know, it is the most important thing that could be. The quarterly reports of the weather which are published will also be very useful for the theory.

---

* See Vienna Conference, page 34.

Rev. R. Main, M.A., F.R.S.

28 April 1874.

All the observations for the quarter are discussed with great care, and curves are drawn of the different elements, and they have been urging on the publication of them with very great vigour. They have two sets going on now, one set to keep up the current ones, and another to get up those which were omitted before. I think they are nearly complete now from the time when they began them, and I consider the whole series to be exceedingly valuable.

14,140. Have you any suggestions to make with respect to the working of that system?—Nothing more than an attempt at an international extension. I do not know anything better with respect to their ordinary working than what is done at present, the publication of those daily bulletins and the quarterly reports.

14,141. You see no objection to the present system so far as regards its being under the management of an unpaid committee; or would you think it more desirable that it should be a regular Government department?—I am scarcely prepared to answer that question. I think it desirable certainly that, if an *unpaid* committee is employed, the members of it should be generally persons who have an intimate knowledge of the requirements of meteorology, and of course they should be all men of very great scientific attainments; but I think that special knowledge is very valuable there.

14,142. May the Commission understand you, on the whole, to be of opinion that the expenditure of 10,000*l.* a year has been productive, to a considerable extent, of good results?—Yes; undoubtedly it was a step in the right direction, and a very important one.

14,143. Do you think that that sum is sufficient for doing all that is desirable?—It is so much larger than the sums we scientific men have to deal with that one hardly knows. Their daily expenditure, I have no doubt, is very great, and without seeing the actual accounts of the way in which the money is expended I could not say. There is a considerable expenditure, no doubt, in lithographing the daily reports; but they ought partly to pay their own expenses, as they are sold.

14,144. In the earlier part of your evidence you stated, I think, that you thought it very desirable that regular observations, during a portion of the year, should be carried on in some northern countries, such as Greenland and Spitzbergen?—Yes, I think so, if there could be stations permanent or otherwise on Spitzbergen and Greenland. The Norwegians will take care of their own country. They are doing a great deal. I do not know that any country is doing so much for northern meteorology as the Norwegians. Professor Mohn has published an Atlas of Storms, which is an exceedingly instructive work, so that the coast of Norway may be fairly left to them. But I think undoubtedly Iceland and Spitzbergen and the coast of Greenland require very particular attention.

14,145. Are the Norwegian observations under the control of their Government?—I think they are made under the auspices of the Norwegian Meteorological Institute, and the Atlas is published with the co-operation of the Scientific Society of Christiania. I was in Christiania last year, and I called and saw their central office there. I did not see Professor Mohn himself, but he is one of the most active meteorologists of the day, and I think the Swedes also are doing very well.

14,146. Such further observations as you think desirable could only be carried on under authority from the Government?—Yes, this would be necessary, because there must be a station, which would of course be a very desolate station, and could scarcely be continued through the winter. It would, no doubt, be very expensive, and might be very troublesome; but I do not see that we can get very much more information without some stations in the Northern Seas.

14,147. If anything of the kind were undertaken, would you place it under the Meteorological Committee?—Yes. I think that the British Government might do something by co-operating with and assisting the efforts of the Swedes. The Swedes are willing to do anything, but they are poor as compared with ourselves, and by a little arrangement with Sweden I have no doubt that a good deal might be done.

14,148. Greenland is a Danish possession?—Yes. Of course both Sweden and Denmark might be called into the Council.

14,149. Are the Danes willing to assist in matters of this kind?—Yes, I think so. The Danes are scientific.

14,150. Are there any observatories of this kind in Iceland?—I dare say there are. I do not remember to have seen any observations, but Iceland is a well inhabited island, and there would be no difficulty in getting observations made. That country is cultivated and civilized, and no doubt there would be no difficulty whatever in getting anything done that we wanted.

14,151. Are those observations in the extreme north those that you consider the most important additions?—I think so, for our own climate a good deal depends upon the Northern Seas, and the disturbances in the Atlantic. Of course one would wish observations from as near the North Pole as possible down to the Mediterranean, because one class of storms that we have come up from Africa and from regions south of the Mediterranean, and we cannot get a very accurate idea of them without stations on the African coast, for instance, at Tripoli, Tunis, and other such places. Algiers sends meteorological telegrams to Paris.

14,152. Are there other matters connected with Meteorology which you would think it desirable that the Government should embrace in their operations?—It is proved that the variations on the sun's surface have a good deal to do with Meteorology, but in a practical sense I do not know whether one would urge the Government to undertake solar physical observations in direct connexion with Meteorology, especially as the establishment at Greenwich does now take the sun under its charge, and has the Kew photo-heliograph, and would be prepared, no doubt, to carry out everything that is necessary there. I do not think anything additional is necessary beyond what Greenwich will do.

14,153. Is there any class of meteorological observations which you think might be very well left to individuals?—The climatic certainly; nothing more needs doing on that head. I have no doubt that from almost every town in England of any size, we could get a good account of every element of the climate. For instance, there are 47 stations that report to the Registrar General quite gratuitously in England and Wales. The results are included in the Registrar General's Reports, and this is all done at a very trifling expense. And that I presume to be the reason that only the coast stations were chosen at first for correspondence with other coast stations in foreign countries. At first it was not intended to take inland stations at all, and these are very few now.

14,154. Do you know what has been done by the Scottish Meteorological Society?—This society was established about the year 1855, and observations made twice a day are communicated to it monthly from 93 stations. For 55 of these stations the reductions are performed at the Royal Observatory of Edinburgh by Professor Piazzi Smyth. For the remaining 38 stations the reductions are made by A. Buchan, Esq., Secretary of the Society, and the results are published in their Quarterly Journal. I do not think that they publish any bulletin; they would not be able to afford it. But I consider that a great deal has been done under Mr. Buchan. The meteorology of Scotland, through the means of the Scottish Meteorological Society, is now known very well indeed, I think.

14,155. There is also an English Meteorological Society, is there not?—Yes. I do not know that that is capable of doing much in the way of co-operation. Papers of some importance are read occasionally, and it is a medium for the publication of observations. For instance, I remember a few years ago, when I was

Rev. R. Main, M.A., F.R.S.

28 April 1874.

in Constantinople, I called, at Scutari, on the observer there, a military man (Sergeant W. H. Lynne, R.E.), who was employed (I presume by the British Government) in making a regular series of meteorological observations, but he complained that he had no means of publishing them. As soon as I came back I put myself in communication with the Meteorological Society, and managed to get those reports from him, and they were published by them; that is one instance of good arising from that society.

14,156. Do you know whether the Meteorological Society is in communication with private observers generally in England?—Not more than the Astronomical Society. It would probably in a smaller degree perform the same office as the Astronomical Society has done; it gives an incentive to private industry in these matters, though this is not so much wanted in England, as we have a sufficiently large number of stations. Almost every gentleman, who wants something to do and has a good house and grounds, likes to do a little in the way of Meteorology, so that we get plenty of stations without much urging.

14,157. What means are there at present for private observers to make known to the public the result of their observations? — The Meteorological Society comes in admirably there, and I think that that is one of the principal uses of societies in affording the means for publication. Several valuable papers are published in the proceedings of the Meteorological Society.

14,158. (*Professor Smith.*) I think you said with respect to the meteorological observations at Greenwich that the reduction of them has commenced?—Yes, it was commenced about the year 1871, and is going on. Nothing has been published as yet, but when the Visitors met last time the Astronomer Royal reported that a good deal had been done, and that it was going on very vigorously.

14,159. Is the method of reduction the same as that which you have employed in the Radcliffe Observatory?—He takes the means according to an original plan. In his last annual report to the Board of Visitors he stated that, "the diurnal changes of the " dry-bulb thermometer, as depending on the month, " on the temperature waves, and on the barometric " waves, have been computed for the whole period " from 1858 to 1868." We may therefore look with some interest to the publication of these results.

14,160. I think you have expressed an opinion that at every astronomical observatory of importance, photographic meteorological observations should be carried on?—I think so. I think that at every fixed observatory it should be done.

14,161. Are such observations carried on at any of the colonial observatories?—At Toronto they are, I think.

14,162. Not at the Cape, for instance?—No, I think not at the Cape.

14,163. Would it be important that those observations should all be reduced on the same plan, if the system should become general?—Yes, I think so, in the same way that ours are. For instance, those results of ours, which I have been pointing out, lose a great part of their value, from their being the results of an isolated point on the earth's surface. When we consider what Meteorology is, that it deals with the great movements in the atmosphere, it is evident that observations at a particular point cannot tell us much under any circumstances; they may give us certain singular results, but if we could trace the law of those results, over a large area of the earth's surface, a great deal more would come from it. The only place where an attempt has been made, is at Liverpool, by a private individual (W. H. Rundell, Esq.), who corresponded some time ago with me. He has discussed some of the Liverpool results very well indeed.

14,164. Would it be important that in a country of the size of England, the stations where photographic meteorological observations were taken should be multiplied?—There is no need of many of them, but the number of observatories that could possibly do anything of that kind it is very small. Cambridge, for instance, might do it with a little addition to its staff, and Dublin might do it, and it might be done at Edinburgh, and those would be pretty nearly all which, I think, would be desirable.

14,165. You would say about five or six in the United Kingdom?—Yes, about five or six. In fact, I have mentioned nearly all the important observatories.

14,166. (*Chairman.*) Can this be done at private observatories?—I do not think that private observatories do it. The papers must be changed, and though they are only changed once every day, or every alternate day, it must be done regularly and systematically, which would confine an amateur too much.

14,167. (*Professor Smith.*) Is the original cost of photographic instruments considerable?—They were in the Radcliffe Observatory before my time, but I should think not. There is nothing very elaborate about them.

14,168. Are they likely to be changed, can there be much improvement in them?—If I were offered new ones freely, I have no doubt that some changes in the instruments might advantageously be made. I should like rather a larger scale, for instance. We have the result of 48 hours in a space of about 14 inches, and I consider that scale rather too small for delicate results, but our barographic results are, notwithstanding, almost comparable in the main with those taken with the utmost accuracy with a standard barometer, and I do not see that we should gain very much by more minute accuracy. The smallness of the scale tries the eyes of those who read off the photographs, because it is so minute. A transparent scale is applied to the paper, and a person who is not very cautious might, by erring by the thickness of an ordinary line, make a very serious difference in the result. It is only a person very much accustomed to such work that could read them out accurately at all. The thermometer results can be read out with rather more ease and precision.

14,169. It is, is it not, upon the photographic observations that you would mainly rely for the future progress of scientific meteorology?—At certain fixed stations; but, for the theory, I think, as I said before, we should rely more upon daily international communications. We want to see graphically represented before the eye what the atmosphere has been doing at a given instant throughout a large area, and all its large movements. We should probably then trace them to their origin sometimes, which we cannot do now.

14,170. Do you conceive that it would be an expenditure of money which would be really conducive to the interest of science, if that expenditure were incurred in connexion with international meteorology?—Undoubtedly; I think if there were any direct action of the Government, that is the direction which it should take; we want daily representations in fact of the movements of the atmosphere over very large areas.

14,171. (*Professor Huxley.*) If you obtained all the facts bearing upon the climate of England from one large circle, would you like to have observations from the Northern Seas and Siberia?—Yes; I think that our climate is especially affected in the spring months by the Northern Seas, but there are other times in the year when it is just as much affected by the southern gales which come up from Africa, and therefore we cannot have too large an area. I should think that the minimum would be from, we will say, as the northern point, the North Cape to the south of the Mediterranean.

14,172. Speaking roughly, would you say a circle with radius of about 2,000 miles?—Yes; probably about that.

14,173. (*Mr. Samuelson.*) I presume that you are not acquainted with the correspondence which has taken place between the Treasury and the Registrar-General and the Meteorological Office with reference to the observations made by Mr. Glaisher or under his

Rev. R. Main, M.A. F.R.S.

28 April 1874.

direction, and the payment made in respect thereof by the Government?—No; I have not seen that correspondence.

14,174. That correspondence has been referred to this Commission, will you have the kindness to look at it (*handing the same to the witness*)?—As I understand the matter, this actually takes out of Mr. Glaisher's hands the grant by which he received 150*l.*, and the grant terminates on the 31st March 1874.

14,175. I believe that the grant has been prolonged?—I was not aware of this correspondence. I must say, personally, that I should be very sorry that it should be taken out of Mr. Glaisher's hands. He states very truly that he has organized the staff of observers, and that many of them send their results partly out of friendship to him and at his personal request, and for various reasons which would not apply if they were to send them to the Meteorological Office generally, and it is very likely that for a time the whole thing would fall through. It is impossible at this moment to say what would be the effect of taking it out of his hands. We should lose, I have no doubt, a good many of the contributors.

14,176. I would call your attention to the letter of Mr. Robert Scott, dated January the 7th, 1873, addressed to the Registrar-General, in which he states that there would be no difficulty on the part of the Meteorological Office in conducting those observations and supplying them free of charge; and he states further, that the Committee "could not undertake to "pay any sum of money out of the grant with the "management of which they are entrusted for work to "be carried on by gentlemen not under the entire con- "trol of and in direct communication with the Com- "mittee," which means, of course, that they would not be prepared to pay any sum of money to Mr. Glaisher?—Yes, that is quite clear. I should think that at the present time it would be very unwise indeed to raise the question, as all is going on so exceedingly well in Mr. Glaisher's hands. As I said, he receives reports from 47 stations and communicates them to the Registrar-General, and the whole business, I believe, is done in an orderly and proper way, he himself being personally responsible for the goodness of the instruments used, the goodness of the observations, and everything else. He takes it upon his own responsibility, and does the whole of the necessary work, and the total expense to the Government is 150*l.* a year. I cannot see that we can, under any other arrangement, get so good results for the money, and the question is, whether we should get them at all to that extent if they were required to be sent to the Meteorological Office.

14,177. There is no doubt in your mind as to the goodness of the results ascertained on the present plan?—They are the best that can be possibly made. I have been visiting different parts of the country, and I have seen some of the stations, and I have seen the attention and zeal of the observers employed. I remember that at Silloth, near Carlisle, where I was staying for a week or two, I made acquaintance with the observer there, the Rev. Francis Redford, and I was surprised at the care and scrupulous exactness with which everything was done. I visited the instruments with him, and saw the zeal which he displayed in the work. I have very little doubt that that is the case with almost all the other observers, and that it arises mainly from the way in which the thing has been done under Mr. Glaisher, and the sort of friendly relation in which they stand towards him. You can get paid assistance of that kind from a great number of stations, but when it is done of free will, it must be done in a very delicate way, and it has been done I think, on the whole, as well as it could possibly be done; that is to say, there are a great number of stations, and the results are of excellent quality. The first thing that Mr. Glaisher did when he undertook this, was to go himself personally to visit all the stations. He began by getting the instrument makers to make alterations in certain instruments, and to send them to him to be tested. No instrument whatever is supplied to a station unless it has his own personal signature accompanying it, and such instruments have all been tested by himself, the thermometers for the temperature, and the barometers for their standard point. That was one great point. I do not think that there is any man in England who has such control over the instrument-makers as he has, and the extreme accuracy of the instruments of the present day compared with the former ones is, I think, mainly due to him. I know that he went personally to inspect the stations themselves, and to give advice to the observers wherever it was required. At one time he used to be travelling up and down on the railways in various directions very much indeed when all this was being settled. He has done all this; it is his own organization, and it would not have existed at all if it had not been for him; and I think that, unless there is very great reason indeed, it is a great pity to attempt to take it out of his hands, or to make any other arrangement. It may go on side by side with the work of the Meteorological Office. It is so much good work being done, which needs not necessarily (at least, at present) to come under the charge of the Meteorological Office.

14,178. I want to call your attention to the last paragraph in Mr. Scott's letter: "I am instructed to "point out to you that they could not undertake to pay "any sum of money out of the grant, with the ma- "nagement of which they are intrusted, for work to "be carried on by any gentleman not under the "entire control of, and in direct communication with "the Committee"?—That is to say that they could not pay Mr. Glaisher; that is quite clear, that would follow as a matter of course, because they would take all the responsibility of collecting the results, and because they must take the responsibility of seeing that everything is right, in fact be responsible for the whole, as Mr. Glaisher is at the present moment.

14,179. Unless they were to employ the agency of Mr. Glaisher?—Yes, but they say that they cannot pay him.

14,180. They cannot pay him, unless he would consent to be entirely under their control?—I am quite sure that Mr. Glaisher will not do that; but that of course is a private question. At the same time I am sorry that the question should have been raised at all by the Meteorological Office at the present time. The Registrar-General's returns have been going on exceedingly well, side by side with the results published by the Meteorological Office. The two did not clash at all, nor interfere.

14,181. The observers, although private observers, are now responsible to Mr. Glaisher?—They are all now responsible to Mr. Glaisher.

14,182. And of course, he takes care, being a scientific man, that that responsibility is not merely nominal?—Precisely so. You have the best possible guarantee from his character, and also from the length of time that the system has existed. He has worked it up into this system, and the breaking down suddenly of such a system would produce a positive mischief. If it had been feared that he was unable to superintend it, and that it might come into other hands, that would be a different question altogether; but I should have thought that, as long as he would continue it, all parties would be only too glad that he is willing to do it. The small remuneration which he receives, should hardly be mentioned.

14,183. Assuming as an extreme case that all private observers who are now supplying observations to Mr. Glaisher should be willing to supply them gratuitously to the Meteorological Office, some superintendence or inspection, on the part of the Office, would still be necessary?—Certainly. Professor Piazzi Smyth does what is necessary in Scotland.

14,184. And that would involve the expenditure of some money?—It would involve a journey sometimes, and other expenses in addition to computers. I cannot understand how Mr. Glaisher has managed to do it himself with so little. He is also obliged to employ one or two computers, and originally he had

Rev. R. Main, M.A., F.R.S.

28 April 1874.

but 100*l.* a year. I am confident that he gains nothing but reputation. He could not then have gained a farthing from it, and I do not suppose that he does now, but it is simply that he has founded it, and that his reputation is involved in it.

14,185. So that the mere discussion of the returns for which Mr. Scott says the Committee has a competent staff would not be all that would be required?—I think not.

14,186. And the superintendence would necessarily involve some expense?—Certainly, in some shape or other, it must involve that, as all superintendence does. It must be paid for.

14,187. The superintendence of 47 stations at 150*l.* a year would probably not be considered by you to be a very heavy charge?—No. I have no hesitation in saying that the Government at the present time, under the Registrar-General, gets its information for nothing, at least it gets Mr. Glaisher's services for nothing; and that the sum which Mr. Glaisher receives is very nearly, if not all, expended upon the necessary expenses which he incurs.

14,188. Which expenses would have to be incurred by some one?—Yes, certainly, and most likely a great deal more. I am surprised at the smallness of the sum.

14,189. So that the transfer of those observations from Mr. Glaisher to the Meteorological Office would probably involve an increase of expense instead of a diminution?—An increase of expense, and no possible gain to science. I do not see that in any case there would be any gain. Supposing, which is an extreme possible case, that we should get it done as well as it is now, what advantage is there in making the change unless for symmetry?

14,190. (*Professor Huxley.*) There would be a small advantage in transferring it to a permanent office, that it would not be then entirely dependant upon Mr. Glaisher, seeing that he is not a young man?—Just so. It will probably be necessary to make some arrangement at some time or other.

14,191. Whatever is done now, in your opinion it would be necessary for the Government to consider the question by and bye; so that it is merely deferring the question?—Quite so. It will have to be considered; but I presume that Mr. Glaisher is willing to continue it, and that the difficulty arises from some technical matter of account with the Treasury. It appears very unwise to have raised the question at all just now; and I fancy it has arisen from the fact of its coming to them, under the head of Meteorology simply, and they do not see why there are two distinct departments paid; but I think that it might be explained to the Government that the objects of the two are very different indeed. The one is connected with climatic meteorology and had its origin in connexion with the sanitary condition of the kingdom, and the other is more connected with physical meteorology.

14,192. (*Chairman.*) Your view is, that if the Meteorological Committee had to take this up, and had to do it out of the 10,000*l.* a year, they would have to reduce some other portion of their work?—Yes, if the whole of that sum of money is expended now. I do not think that there would be any ultimate saving to the Government in any case. They would come upon them for some further grant if the money were expended.

14,193. (*Professor Huxley.*) Do you think that there is any reason why the Meteorological Committee should not take up that kind of meteorological observation?—No; ultimately I do not see any reason. I think it is very proper that a little more centralization should be used; but what I observe is, that it is unwise now to raise the question, when it is going on so well; when here is a gentleman of the highest capabilities for this employment, who has made it the business of his life, whose scientific career has been wholly devoted to it, and we are getting the results of all his experience and knowledge, and of his tact in inducing observers to take the work, and to do it well, without any expense.

14,194. Your objection is to removing it from Mr Glaisher's hands now. You do not give us that opinion with reference to future arrangements?—No, certainly not. Some arrangement must be made after he is obliged to give it up.

14,195. (*Dr. Sharpey.*) Do you presume that 47 stations would be required in future to make those returns?—Yes; and that is a point which requires consideration, in fact the sanitary condition of the kingdom makes it desirable that every locality should have its observers. There are not too many stations; you cannot have too many. It every town of the British Isles, I think, there ought to be meteorological observations, especially, for instance, observations of the ozone, on which the public health depends more than on anything else. The quantity of ozone in two streets of a town sometimes very materially differs, and will give an indication of the probable health of the inhabitants. I merely mention that as a single instance of the importance of having every element.

14,196. (*Mr. Samuelson.*) If those observations had to be taken for the first time to-day, do you think that they should be properly entrusted to the Meteorological Office?—I think they might be, only the Meteorological Office must consider that they are for a purpose distinct from their present work. That sanitary point of view must be kept before them.

14,197. And to subordinate Mr. Glaisher to the Meteorological Office is an arrangement which you do not think would work?—I do not think it would work at all.

14,198. I will draw your attention to Appendix I. of the report of the Meteorological Committee of the Royal Society for 1872, in which you will see that a payment there is included of a sum of 2,632*l.* 1*s.* 8*d.* for expenses at observatories. I believe that Oxford is one of their stations under your direction?—Yes.

14,199. Would you be so good as to state to the Commissioners what sum out of the 2,632*l.* 1*s.* 8*d.* is paid to Oxford?—13*l.* for the year, that is 5*s.* a week, and the instruments are our own, and kept up at our own expense.

14,200. In the report for 1870 there is a charge of 978*l.* 17*s.* 3*d.* for new instruments. Have you received any portion of that?—Nothing.

14,201. There is a distinction, I believe, as regards the sums disbursed by the Meteorological Office between certain original stations and stations which have since been added?—The photographic records or copies of them are sent to the office from the original stations, and the results are given graphically and published in the Quarterly Weather Reports. The new stations, including the Radcliffe Observatory, send only one telegram daily containing the elements of the weather at 8 a.m. Ours is an observatory with self-recording instruments, but not supplied by the Meteorological Office, and it could easily send copies of the photographic records. But new instruments are charged distinctly to these observatories, and it does not come into the charge of 2,632*l.*? At Glasgow the instruments that they are using belong to the Meteorological Office, I presume.

14,202. Assume the instruments to exist, at what expense do you think one of the seven stations, having self-recording instruments, could be conducted, supposing them to be supplied with instruments?—I should think, speaking in round numbers, for 150*l.* a year, that is including the repairs of instruments, chemicals, and various other things that might be required, but that is the outside. 150*l.* a year, I think, is ample and leaving a margin.

14,203. That would be 1,050*l.* for the seven principal stations, leaving a margin of 1,563*l.* for those stations not originated by the Government, out of which you receive 13*l.*?—Yes, out of which we receive 13*l.* Indeed, I should say that we do not receive that, because it is necessary to pay the boy to carry the messages. In fact, what we receive is merely nominal. Mr. Lucas may get a trifling benefit from it, but I leave it to him.

14,204. (*Professor Huxley.*) Do you think that you

Rev. R. Main, M.A., F.R.S.

28 April 1874.

could get competent and distinguished men for all these stations to take charge of them, and give themselves up entirely to them for 100*l.* a year ?—Under a director one of the ordinary assistants could easily be rendered quite competent for the duties required.

14,205. But the stations that we are now referring to are not under a director ?—The principal stations ought to be under a competent person. One, I know, is under my friend Professor Grant, at Glasgow, and Armagh is under a competent head, Dr. Robinson. With regard to Falmouth, I do not know that there is any observatory there. At Stonyhurst there is, I imagine, a competent head. At Aberdeen I do not know whether there is an observatory, and Valencia is a most important station undoubtedly. Where there is no chief, and it is necessary to have a man of character to make the observations, of course the salary must be higher, but the mere addition to the expense of a fixed observatory like ours, ought not, I say, to be more than 150*l.* a year. If, for instance, a grant could be made to us of any kind to that amount, (though I do not desire it from the Government), it would be, I consider, of great service to science. We could carry on our meteorological observations very much better, and extend our operations if we had a little more money ; but I am very anxious now, as the Trustees pay for everything, to keep down the estimates as much as possible. I have no doubt that everything relating to the expense of Ocean Meteorology is all right, and that the superintendent's salary of 400*l.* a year is very moderate.

14,206. (*Chairman.*) What proportion of the whole expense goes in Ocean Meteorology ?—The greater part of the expense is for land meteorology, which I do not think the nation gets a fair return for. The telegraphy would naturally be a great expense. The heavy sum is certainly for land meteorology, and so far as I can see a great portion of that is absorbed by these seven stations.

14,207. (*Mr. Samuelson.*) Would not the computations for which 831*l.* is charged be done in London ?—I suppose so. Still, everything is on a large scale. But as to what is charged for computations, I understand that what is meant by computations is a work of a most trivial character in comparison with the quarterly reports. There may be a good deal of taking means and that sort of thing, which requires a man with clerk-like habits ; but there is very little that is scientific in it.

14,208. (*Professor Smith.*) Very different from the reductions which are necessary for the computations which you have given us ?—Very different indeed. There is nothing but the ordinary meteorological reduction, taking means, and things of that kind, and applying certain corrections.

14,209. (*Mr. Samuelson.*) Still the amount of work would be large ?—Yes ; the amount of work would be very great indeed, as they receive observations from so many stations.

14,210. (*Chairman.*) Is there any other point in connexion with the subject on which you could make any addition to your evidence ?—I am not aware of any.

The witness withdrew.

Major-General Richard Strachey, R.E., F.R.S., further examined.

Maj. Gen. R. Strachey, R.E., F.R.S.

28 April 1874

14,211. (*Chairman.*) I believe you are a member of the Meteorological Committee ?—Yes, I am.

14,212. You are thoroughly acquainted with the object for which the Committee was appointed ?—I believe that I am. The general raison d'être of the Committee is fully explained in their earlier Reports. I daresay Mr. Scott has already gone into full detail on that subject, but I think that it may be advantageous if I also say what I understand to be the main objects for which it was formed, because it will show that there is no confusion of ideas in anything I may say hereafter on the manner in which the Committee actually executes its duties. I would, then, state generally what I understand to be the objects which the Meteorological Committee has to superintend. These are, first, the collection of meteorological data from ships' logs, with a view to the preparation of maps for the use of sailors, showing the probable, or it may be termed the average, meteorological elements all over the ocean, on the chief line of trade routes, for the several months in the year. Included with these is the investigation of the ocean currents. This branch of duties is carried on under Captain Toynbee. The second branch of the business is the collection and daily publication of meteorological observations made on the British Isles and neighbouring coasts, extending from the coasts of Scandinavia to France, and partly to Spain. Although at the outset the issue of warnings as to probable bad weather was not contemplated, yet after the Committee had been in operation for a few months it was considered desirable again to undertake this and in the first year of the Committee's existence the issue of warnings of anticipated stormy weather was resumed. I daresay Mr. Scott has told the Commissioners, that within the last few months there has been a little more detail given in the warnings. Originally they were mere warnings that stormy weather was likely to occur. Now there is a statement also given of the probable direction from which the wind is to come, and whether it will be of extreme force. The third of the objects is the recording at certain specially-organised observatories, seven in number, maintained under the direction of the Committee, of the principal meteorological elements, with self-recording instruments ; with the intention of obtaining a continuous record with as great accuracy and precision as possible, and thus of procuring accurate data for the scientific study of meteorology by all persons who are interested in that science. I should add that the Committee has, within the last month or two, from the commencement of this year in fact, begun to print and to issue monthly the detailed observations made at these seven observatories. The Committee also publishes quarterly reports, which contain diagrams embodying the observations at the seven observatories, and an analysis of the weather over the British isles, of which the details are furnished in the daily reports. There is no doubt that the publication of those quarterly reports is an useful addition to the daily reports, which are extremely voluminous, and not very easy for persons to follow who do not devote themselves to the subject. The last of the specific duties of the Committee is the supply of meteorological instruments for the Royal Navy and Mercantile Marine. Besides, various miscellaneous references come from the Board of Trade, to which, of course, the Committee gives such answers as it is capable of doing.

14,213. Do you know how it happened that those matters came to be placed in the hands of the Committee ?—As I understand, the Board of Trade, in the course of events, found that they had thrown upon them the duty of superintending matters involving more or less special scientific knowledge which they were not able very satisfactorily to control ; it was suggested that a committee of scientific persons, who had given their attention to such subjects, would be a better body to undertake the supervision of those matters than the department itself.

14,214. Did the Royal Society, in undertaking to nominate the Committee, take upon itself any further responsibility in the matter ?—No ; on the contrary, the Royal Society has always distinctly stated that it has no specific responsibility for any of the acts of the Committee, and that all the Society does is to select, on behalf of the Board of Trade, suitable persons to form the Committee.

14,215. Has the nature of the proceedings of the Committee been influenced by the previous proceedings of the Board of Trade ?—I think this is obviously the case, and that the Committee is now in reality

Maj.-Gen. R. Strachey, R.E., F.R.S.

28 April 1874.

doing no more than continuing the exercise of certain functions which had, in the course of time, been thrown upon the Board of Trade by the position which that department occupies in connexion with the public administration. I mean more particularly in dealing with the calls which from time to time were made upon the Government to give administrative assistance for the application of scientific knowledge, particularly in those matters which concern that part of the community who go to sea, including the Navy and Mercantile Marine. Then questions referring to the public health have led to a desire to get more accurate information as to the climate of the country, it having been gradually appreciated that climatic changes have an important effect upon the public health; and similar information has been seen to be desirable as regards all matters connected with agriculture. The Committee has, in a measure, been made responsible for furnishing such information to the public in the matter of weather, which, of course, is very important.

14,216. Has the consequence been that the action of the Committee has been from the outset rather in a practical direction than in one of original research or scientific observation, properly so called?—I think distinctly that such is the case, and that it has necessarily followed from the position in which the Committee was placed. If a reference is made to the earlier papers, and to the Report of the gentlemen on whose suggestions the present arrangements originated, there perhaps is an indication that they anticipated something more in the way of scientific research than has actually occurred; but the turn that things have taken seems to me the necessary result of the sort of duties that were put upon the Committee under the essential condition that it had but a limited sum of money to spend.

14,217. Have any results of scientific importance in your opinion been obtained by the action of the Committee?—In the direction of what one may call investigation of an absolutely scientific character, I should say none at all. Of course the observations that are made at the special observatories are valuable scientific information, and so far one has no right to say that scientific results have not been produced; but I do not think that these can properly be referred to as specific results of anything that the Committee has done. To the best of my belief there has been nothing undertaken in the way of original investigation into the specific physical causes of any of the phenomena which are recorded, nor any original research, properly so called, in relation to any of the several branches of meteorology. The Committee hardly has appliances at its command for any such investigations, and the funds at its disposal being limited it was hardly possible that it should attempt them. It is also no doubt quite true that the observations which are made at the seven observatories do not include many matters which are of great importance in physical science, and which would properly come within the range of meteorology.

14,218. Are the funds at the disposal of the Committee in your opinion insufficient for doing anything more than has been actually done at present?—I should say distinctly that this is the case. The Committee has always considered that it is bound to attend primarily to the special objects before referred to, which were in a specific manner made over to it, and it finds that after this has been done there is no money left for other things.

14,219. Has the Committee considerable control over the expenditure of the fund; if they think too much is going in one direction, could they put a stop to it, and turn the expenditure in another direction?—I am not aware that there has ever been any interference with the powers of the Committee in the way of spending the grant, but I presume that without a specific authority from the Board of Trade they could not modify the general system on which their work has been carried on up to the present time.

14,220. Do you consider that the directions in which money was to be expended were prescribed to the Committee by the Board of Trade?—Yes, so I understand. I understand that the Committee have a fixed programme, so to speak, which they have to follow in its general outlines.

14,221. Practically is the expenditure chiefly at the discretion of Mr. Scott?—To some extent, at all events; though hardly at his full discretion. He is the executive officer under whom all expenditure takes place, but the bulk of the money is paid away either in salaries or in telegraphic charges, so that one cannot say that Mr. Scott has any properly called discretion in the expenditure of the money. All the salaries are fixed by the Committee, and of course the charges for telegraphic messages are fixed according to the regular tariff.

14,222. Has the proportion in which the money is applied to the different objects of the Committee remained nearly stationary?—Very nearly, to the best of my belief; and such changes as seem to have taken place I think are rather apparent than real, and have arisen from transfers from one head of charge in the classification of the expenditure to another.

14,223. Do you consider all the objects as of great public importance?—I think that they all have a certain value, and that it is quite right that some public authority should attend to them.

14,224. You think that they are things that properly may be provided by the State?—Yes, I think so. I think that there are various reasons for considering meteorology to be a science in which it is extremely difficult to make any progress without assistance from the State. Meteorology is a science of extreme complexity, and no doubt it will take a very long time before it comes really to be worthy of the name of a matured science. From the manner in which the physical forces operate which produce atmospheric phenomena, it becomes necessary for their proper apprehension to view the conditions of a very large area simultaneously, as those conditions change from hour to hour or from day to day, or from one season of the year to another, and hence it is absolutely necessary that there shall be not only continuity but a very considerable breadth of view to insure success. For my own part I think that all experience has shown that observations such as are required are practically beyond the reach of private effort, and that the only chance of getting what is wanted done is through the assistance of the State. Neither does it seem to me that there is any greater reason for the State supporting observatories to be specially devoted to astronomy, for instance, than those to be devoted to physics or to meteorology; and although I should say that it would be an act of abominable barbarism to abolish the Observatory at Greenwich, it seems to me that there is no possible reason for its maintenance at the expense of the nation, which would not apply with equal or perhaps greater force to the endowment of observatories and laboratories of other descriptions.

14,225. Is it your opinion that the State should do much more for the promotion of meteorological science than it does at present?—Certainly it is, most decidedly.

14,226. Can you state the directions in which you think the State should intervene?—This seems to me an extremely difficult question to answer. The fact is that the form in which the State might in a satisfactory way intervene must depend upon the extent to which it is disposed to intervene. If one knew that the Government really desired to assist in the development of scientific meteorology, it would be possible to make a scheme; but I do not see how anybody could make what I may call an abstract plan which should have any real utility in it. My own impression is that so long as there is no greater interest taken in this sort of matter than at present, probably the best thing to do is to leave the expenditure of what money the Government choose to give for the purpose under the control of some such body as our Committee; but I should further say that if the Government is seriously in earnest in taking the matter up, it would then be the proper thing to have a public department that should manage the business. Then again, if there were a public department, it must be a part of an organised system; and in order to secure an efficient public department to supervise such matters, it seems to me that it would be necessary to have some officer connected directly with the Government, an Under-Secretary of State, or some such person, who should be responsible that the executive scientific staff properly carried out the whole of the operations of their several departments.

14,227. Do you know at all what is done by other nations in this matter; has more provision been made elsewhere than in this country?—There is no question of that at all. I am not in a position to give any details; I suppose that some nations do more and some nations do less; but it is perfectly notorious that the United States, for instance, spend vastly more on meteorological science than we do.

14,228. And has the result been that meteorological science owes more to the United States than to this country?—I should think it certainly does. I may add, as I believe I said when I was examined before by this Commission, that my own impression is that the study of meteorology would be much more easily carried out to a satisfactory conclusion in a tropical country than in a country like this, which is so near the north pole, and where the disturbances are so extremely great as compared to what one may call the normal influences. Near the tropics, on the other hand, the disturbances are comparatively small, and the regular influences are extremely great, and I think we are much more likely to arrive at a satisfactory result where the normal forces are most strong and the disturbances least. And for that reason I have always done what I could to try and persuade the Government in India to do something in the way of meteorology there. But unfortunately that Government is extremely poor. From causes similar to those that have operated in England, the persons who control the acts of the Government do not know much about science, and do not care much about it, and it is extremely difficult to get anything done; but a little has been done, and of late years some improvement has been made.

14,229. In carrying on the business of the Committee, do subjects from time to time present themselves which you would be desirous of ncluding, but which your funds do not permit you to include?—I think so, certainly.

14,230. What objects are you obliged to neglect from the insufficiency of your funds? Without enlarging the scheme altogether, are there any matters which you are obliged to pass by?—You may say in general terms that anything like a scientific analysis of the observations is prevented. There are no funds from which to pay anybody who could take up scientific investigations or deductions from the phenomena that have been observed.

14,231. And do you think that a number of observations are made of which no great use is made, which are not turned to the purposes to which they might be made available?—I am afraid that has been and is the normal condition of meteorology, that our shelves are filled with volumes containing masses of figures which practically nobody uses, or does much more than keep on their shelves. But I am not prepared to say that it necessarily follows that those figures are useless because they are not worked up into a very definite form. I think that the progress of knowledge, generally speaking, is accompanied by a very great deal of what on the surface appears to be useless labour and useless research. Before any good result is accomplished in anything, there is an enormous quantity of nonsense talked about it, and it is commonly set about in the wrong way. The process may be compared to the propagation of creatures in the organic world, in which an enormous effort is apparently necessary to produce any result at all, so that in a certain sense three fourths or more of the reproductive energies of nature are wasted, though eventually something comes of it.

14,232. (*Professor Smith.*) Are the observations that you are referring to as existing in great masses and very little used, observations that have been printed or that are kept in manuscript?—Both sorts.

14,233. (*Mr. Samuelson.*) I think you are aware of the correspondence which has taken place between the Registrar General and the Meteorological Committee and the Treasury, which has been referred to this Commission?—Yes.

14,234. With reference to that correspondence, I will ask you whether a letter dated January the 7th, 1873, from Mr. Scott to the Registrar General, was considered by the Committee?—Yes, I do not doubt that it was.

14,235. So that to all intents and purposes it was the act of the Committee?—Yes, practically it was so.

14,236. The Committee of course is aware of what has been done by Mr. Glaisher in the way of observations on climatic meteorology?—Yes, certainly.

14,237. And that he has the charge of some 47 stations furnishing important information to the Registrar General's office?—Yes; but I should explain that I have only a general knowledge of these circumstances, and no detailed knowledge, except what I have heard from people talking about it. As to Mr. Glaisher's connexion with the Registrar General, I have no personal knowledge derived from any inquiries that I have ever specifically made myself.

14,238. I assume that some specific knowledge must have been before the Committee, for Mr. Scott, on behalf of the Committee, as I understand, undertook to do gratis what Mr. Glaisher has hitherto done for the Registrar General?—I am not aware that Mr. Scott ever did that, and I am not aware that the Committee ever said it. As I understand it, what Mr. Scott says in this letter, and what the Committee intended him to say, is, that certain meteorological registers appear in the Registrar General's Reports, and that similar data could be supplied by the Meteorological Committee. I do not think it said anything more than that.

14,239. And, therefore, of course the Committee must have been aware of what the nature of those returns was?—Yes, because they are published in the Registrar General's Report, but I do not exactly see what connexion that has with Mr. Glaisher. It so happens that Mr. Glaisher's name is put at the top or at the bottom of some of the registers, but in the Committee offering or saying that they thought they were in a position to give similar information, there was no special reference to Mr. Glaisher, or anything that he had to do with the reports.

14,240. At any rate that they would be prepared to furnish the equivalent of the information which had been furnished to the Registrar General, and which information happened to be furnished by Mr. Glaisher?—Yes, they say that there would be no difficulty in supplying information of a similar character.

14,241. Mr. Scott here states that "the Committee "having a staff competent to discuss the returns "would be most happy to meet the wishes of the "Treasury by supplying such returns free of charge;" but the Committee would of course take into account that it would not be sufficient to discuss the returns unless those returns had been previously obtained?—I should say that they could not discuss them if they had not the returns.

14,242. Then there would be the expense of obtaining those returns from some 47 stations?—My impression is that the view that the Committee had on the subject is sufficiently stated in the letter. It states that "several private observers whose names "appear in the returns already supply observations to "this office, and the Committee think it probable that "a larger proportion of the remainder would do so if "requested;" and these are the observations which, as far as my recollection goes, Mr. Scott had reason

Maj.-Gen. R. Strachey, R.E., F.R.S.

28 April 1874.

to suppose that he could get readily and practically without expense.

14,243. Of course assuming that all the private observers who had previously supplied information to the Registrar General were willing to supply that information gratuitously to the Meteorological Office, some expense would still be incurred in verifying those observations ?—I presume that Mr. Scott considered, as he says here, that "the Committee has a staff competent to discuss the returns," which means in reality merely to put them into shape, for that is the only discussion.

14,244. But something more would be required than the mere discussion of the returns, because some guarantee would be required, would it not, that those observations were faithfully made ?—Within certain limits I suppose that would be the case.

14,245. The Committee appear to attach some importance to the verification of those returns, because, in the final paragraph of the letter, Mr. Scott says,—"I am instructed to point out to you that they could not undertake to pay any sum of money out of the grant with the management of which they are intrusted, for work to be carried on by any gentleman not under the entire control of and in direct communication with the Committee" ?—I think that represents the truth.

14,246. That is to say, that some superintendence would be required, and I suppose that superintendence would involve some expense ?—I do not exactly know why that paragraph was inserted, to tell you the truth, but I believe it states the fact.

14,247. Do you recollect what is the number of stations now under the directions of the Meteorological Committee ?—I fear that I have rather, unintentionally, been leading you astray in thinking I was on the Committee at the time this letter was written. In fact I was not; but the discussion on this matter has been continued to the present time, and I did not at first observe the dates of the correspondence.

14,248. In fact, personally you would rather not be responsible for this letter ?—If I was not on the Committee, whether I wished it or not, I could not be.

14,249. The Committee are virtually responsible, are they not, for the duties of the Meteorological Survey ?—Yes, for the operations that are carried on under Mr. Scott.

14,250. Then there is no great analogy between the position of Mr. Scott, who is called a director, and that, for instance, of the Director of the Geological Survey ?—No, I think not. I think that Mr. Scott practically consults the Committee upon all the measures that he institutes or carries out; and as far as my knowledge of the Director of the Geological Survey goes, he manages his work altogether in his own way.

14,251. That is to say, the Committee is really the head of this department to all intents and purposes ?—Within certain limits.

14,252. (*Chairman.*) Are they called upon to meet pretty frequently ?—Yes, we meet sometimes once a week, but once a fortnight regularly.

14,253. (*Mr. Samuelson.*) What is the extent of their responsibility ?—As far as my knowledge goes, Mr. Scott practically is responsible for the whole of the executive work, and the Committee exercise over his operations a general control.

14,254. Then, in point of fact, Mr. Scott is the Director of the Meteorological Office, under the superintendence of the Committee as a *quasi* visiting board ?—I should presume that to be a very fair representation of the position. But my impression is, that the special function which the Committee have to perform is to look after the expenditure of the annual grant of 10,000*l.* made for meteorological observations. I have no specific knowledge on the subject, but I should presume that the Board of Trade thought that it was more satisfactory to have a body like the Committee to look after the expenditure of a large sum of money like that, than to hand it over to what you may call, without intending to use the term disrespectfully, a subordinate officer.

14,255. But as to what the functions of the Meteorological Office are, and ought to be, and as to any changes from time to time, you consider that Mr. Scott is virtually the originator, and that he is the responsible person ?—I do not exactly understand the scope of your question.

14,256. Assuming the question to be whether any new work should be undertaken by the office, would that be a question, in the first instance, which Mr. Scott would have to consider and bring before you ?—Certainly.

14,257. It would not be a question which would originate with the Committee ?—In general terms nothing originates with the Committee, everything originates with Mr. Scott.

14,258. (*Professor Huxley.*) But you do not bind yourselves to the Committee originating nothing ?—No. My last answer, I see, may lead to some misconception. I had reference to the regular duties of the office, and to the manner in which they were performed. Of course any member of the Committee may make any proposals that he thinks fit, and many proposals have been so made. But the fact is that every member of the Committee has got a great deal of other work to do, while the whole of Mr. Scott's time is devoted to that particular work, and it is the natural thing that he should do what he is specially employed to do and is paid for; he exercises full discretion in bringing forward any matters he pleases connected with the business of the Committee.

14,259. (*Chairman.*) If the Committee were to undertake to furnish the returns to the Registrar General that are now supplied by Mr. Glaisher, have you any apprehensions that they would be obliged to reduce their work in other directions ?—I have no reason to suppose that. Mr. Scott is a very trustworthy person, to the best of my belief, and from what I have seen of him; and if he tells the Committee that he could prepare similar returns without additional charge, I have no reason to doubt that he could. Of course, as I do not know how every clerk in the office is employed all day, I can give no independent opinion on the subject myself.

14,260. He says that he wants more clerks and more money to do the work which has already been undertaken by the Committee ?—Possibly; but this may mean only that the work would be better done with more power. I cannot say whether he means that he would specifically supply returns of the barometer and the thermometer, and so forth, from every one of the stations that is contained in the Registrar General's register, or whether he merely means to say that he could supply what to his judgment would be fair meteorological returns to illustrate the general conditions of the climate of England.

14,261. The Scottish Meteorological Society, I think, have asked to be allowed to share in the sum of 10,000*l.* granted for meteorological observations ?—Yes; there has been a long-continued discussion of the subject.

14,262. Are you acquainted with the nature of the discussion ?—In a general way, as I understand, the proposition is something of this sort: the Scottish Meteorological Society would like to have more funds at their disposal, which no doubt, if they had, they would be able to apply very usefully; and seeing that the Government gives 10,000*l.* a year to be spent on meteorology in some form, they have suggested that they should have a portion of it. Then it has been suggested that the portion of the meteorological observations which comes to the Committee from Scotland should be collected in the first instance by the Scottish Society; and that if an arrangement of that kind were made the Scottish Society might properly receive a corresponding share of the grant, and this I understand to have been estimated at 200*l.* The answer that has been given to this by the Meteorological Committee is something as follows: that we are not authorised under the conditions according to which we receive our 10,000*l.* to do anything but to spend it on specific objects, and we do not feel

Maj.-Gen. R. Strachey, R.E., F.R.S.

28 April 1874.

ourselves to be justified in making a grant of 200*l.*, or of any specific sum, to another body for the purpose of doing the sort of work that we ourselves are doing. All that we feel ourselves to be justified in doing is actually to apply the money directly to the objects for which it was entrusted to us. Further, the Committee understood that the Scottish Society declined to receive the money as agents, so to speak, of the Meteorological Committee. They were understood to say, we will take it and spend it in our own way and give you our results, but we cannot accept the position of making the observations under your instructions or control. Now the position of the Meteorological Committee is, that they are responsible to the Board of Trade and to the country that particular information shall be got and shall be published day by day in a particular manner, and it has appeared to them that unless they can secure with complete certainty the regular fulfilment of that duty, they would not be justified in handing it over to anybody else on the chance that it might or it might not be carried out; and that, consequently, unless they retain the entire responsibility for the whole of the operations they would be going beyond what they have a right to do.

14,263. Are the Scottish Society's observations at all of the same character and with the same objects as those under the charge of the Meteorological Committee?—I fancy quite so. I do not think there is any distinction at all in the nature of the observations. I have not the least doubt in the world that the Scottish Society would be perfectly capable of superintending them and sending them forward regularly.

14,264. Then, to a certain extent, is not the work done over twice, that is to say, is it not unnecessarily repeated?—One of the specific causes of complaint of the Scottish Society was that the Meteorological Committee got one of their observers to supply the Committee with observations, and therefore, to a certain extent, the work is done over again. But my impression is that the duties entrusted to the Meteorological Committee are much more specific in their nature than might appear from the general course of the latter part of the questions that have been put to me; and that really the principal duty of the Committee as regards British meteorology is to collate the daily weather reports with the view of ascertaining whether in fact there is any probability of a serious destructive wind occurring on any part of the coast. The whole system of observation, as I understand it, is framed on that understanding. No doubt observations framed with that intention must to a very great extent embrace the whole area of the British Isles, and in a certain sense they give you a fair view of the general meteorological conditions of the whole country. The quarterly reports that are published by the Committee (excluding the registers of the seven special observatories, and a few special reports) are nothing more than an intelligent abstract in a continuous form of those daily reports, and the conclusions that are based upon them. Before leaving the question of the grant to the Scottish Society, I should say that the Meteorological Committee felt that if they did make or propose to make a grant of any description to the Scottish Society, there was no reason why the London Society should not get a similar grant, and as a matter of fact the London Society have pretty well asked for it, or at all events they have suggested that whatever is done to the Scottish Society should be done to them.

14,265. (*Dr. Sharpey.*) Have the London Society a set of observers?—No, not of paid observers I think, but they collect observations from a great number of gentlemen all over the country, who go to very great pains and very considerable expense in making observations, and having done that they are very ready to send them to that society, or to the Meteorological Committee, to get them published, and to get them amalgamated with the other similar returns.

14,266. (*Chairman.*) Is Mr. Scott in the habit of bringing details of that kind under the consideration of the Committee, or does he manage it at his own discretion?—The whole of the details come before the Committee, and the whole expenditure is sanctioned in detail. There was a meeting of the Committee yesterday, specially to examine the monthly accounts and to authorise the payments.

14,267. Are you ever in communication at all with the London Meteorological Society?—My impression is that a letter has been received from them, but not for any practical purposes of meteorology.

14,268. You do not mutually assist each other in fact?—Not at all. There is no relation at all between the Committee and any other scientific body. The Committee, if I am not mistaken, has purposely abstained from giving opinions on any but practical questions, though ready to receive all communications. The principal external relations, so to speak, of the Committee are with the directors of meteorology in foreign countries.

14,269. (*Professor Huxley.*) I presume that you attach considerable value to information upon climatic conditions?—Most certainly.

14,270. Looking at the matter as a meteorologist simply, without reference to your being a member of the Committee, supposing that you had to organise a system for the obtaining of such information as that, would you prefer to obtain it by means of a body like the Meteorological Committee, which has a definite continual existence, or would you prefer to leave it to private effort and the effort of societies?—My belief is that private efforts of individuals will be able to do a very great deal, but they will not be able to do much that can be done by a centralised and organised body like the Committee, particularly as it has funds at its disposal. I utterly disbelieve, that any body, if it had not a grant of public money, could secure a regular and a complete periodical publication at short intervals of such returns as are published by our Committee. In fact, looking at the expense of it, it is absolutely prohibitory. However rich any of the scientific societies are, the richest of them would be perfectly unable to do even so much, and that after all is by no means all that is desirable.

14,271. But at present, as I understand, you do not profess to supply the information as to general climatic conditions; your observations are made at fixed stations, either with reference to the purposes of the navigator, or else obtaining the data of scientific meteorology. They have not been extended over such a large number of stations as would be requisite to supply the sort of information which the Registrar General now publishes?—The number is certainly not so large.

14,272. As to its kind, you have not supplied the kind of information which is obtained by Mr. Glaisher from his 47 stations?—Not perhaps to that extent. The attempt has never been made to cover the country with meteorological stations for the purpose of ascertaining the climatic conditions of every square mile of the surface, so to speak, or in any detail.

14,273. Do you think it is desirable that that should be done; that we should have such accurate and systematically obtained information concerning the climatic conditions all over the country?—It is rather a difficult question to answer offhand, but my impression is that it would not be desirable to go to any very great expense to do that; I should consider that the essential scientific points connected with the meteorology of the country would be quite sufficiently arrived at by observations made at a comparatively few points in the country, and that the local details were of relatively minor importance, and that there was no necessity at all for devoting the expenditure of public money to any such detailed collection of facts, the value of which in a certain sense need not, however, be questioned.

14,274. At the present moment about 150*l* apparently of public money is so expended in the payment from the Registrar General to Mr. Glaisher?—I understand that to be the sum.

14,275. I suppose that the sort of observations that are to be included under the head of climatic meteorology are not of the rigorously exact kind which are made in your seven observatories?—Certainly not.

Maj.-Gen. R. Strachey, R.E., F.R.S.

28 April 1874.

14,276. And it cannot be so?—Certainly not.

14,277. Are they observations which could be made under the superintendence of the health officers over the country?—I should say they would unquestionably.

14,278. There is no such special difficulty about it that they could not be made?—Certainly not; what is wanted is that the observer should have proper instruments, and should receive instructions as to what he should do. If you make him understand what he has got to do, he has no difficulty in doing it.

14,279. I suppose that if the health officer supplied that information to the Meteorological Office, it would not involve any very great expense to receive, collect, and publish the information?—I should think very little.

14,280. It would not be any very serious demand upon the time of your office, would it?—Of course that entirely depends upon the amount of the detail which may be required; but I confess that I myself should doubt whether the precise meteorological or climatic conditions of any particular town or district can be connected with the precise conditions of life or of health in that town or that district. I think after all that the meteorological tables which are to be found in the Registrar General's reports rather give a general indication of the state of the weather in the country at large during the year of which he treats than anything else.

14,281. You mean that the connexion between meteorological conditions and the public health is still imperfectly made out?—I mean that all that can be done at present is to establish a general connexion. For instance, if in the month of April we have had a comparatively warm month, the figures would represent that the month of April this year, as compared with other months of April, had been comparatively warm, and a comparison of the conditions of health of the two years might indicate some general connexion between the health and the range of temperature. But they would not afford data on which one could safely say that the health of this town has been good because the temperature there has been a degree higher, and the health of that town has been bad because the temperature there has been a degree lower, and so forth. In my opinion, comparing a series of places near one another, no precise connexion can be established between the variations in the state of the public health and the condition of the thermometer and the barometer.

14,282. So that there is no particular use from that point of view in keeping a register of the weather along with a register of births and deaths?—Not at every place where a register of births and deaths is kept, I should think. Of course, in all of these things, and particularly as regards the registers of the weather, a further difficulty arises from the expense of publication. You get together a huge pile of figures, and you do not know what to do with them when you have got them.

14,283. Do you know anything actually of Mr. Glaisher's system;—Not the least.

14,284. You can give no opinion about it?—Not at all. I was led to understand from figures that were pointed out to me (and I think there was some correspondence between the Registrar General and Mr. Scott on the subject), that there were several blunders in the registers, but that they are like other ordinary meteorological returns I should think is probable. I am not aware that they have any particular value, or that they are in fact different from similar sets of figures got in other ways.

14,285. Are you disposed to think that the Meteorological Committee might in any way extend its sphere of action with advantage?—As matters are now I should think it is extremely doubtful. I look upon the Meteorological Committee as being mainly a controlling body to supervise the expenditure of a definite sum of money in a definite way. At all events that practically has been their position. There has been no virtual change from the time that they were started up to the present time.

14,286. Do you think that that money would be spent better in some other way; that is to say, supposing the thing had to be started afresh, are those objects which the Committee at present have to carry out exactly those that you would have given them to carry out?—I should say in general terms that the whole of the objects which the Committee has charge of are reasonable objects. I do not think that there is any one of them that it is not desirable to attend to. As to whether the precise method of dealing with them is the best possible will be a matter of opinion, but I do not think that I could very usefully go into that.

14,287. Does it occur to you that there is anything else which should be added to the functions of the Committee?—My general impression, as I implied before, is that the Committee is a quasi-financial body having certain scientific knowledge. Its duty is not strictly speaking to direct scientific research or scientific operations, but it is to see that a certain sum of money which the Government thinks may reasonably be applied to collecting and publishing meteorological observations, and doing certain other matters, is not unreasonably applied. It exercises a check upon the persons who have actually to carry out those duties, as I understand it; and I do not think myself that, with a body constituted as the Meteorological Committee is, you can expect more from it than that.

14,288. Do you think it would be desirable that the Committee should be entrusted with money to enable it to have any observations collected, scientifically discussed, and turned to scientific use?—I think it would be much better if any such fund were not given to a body like the Committee. If some individual were selected, and the entire responsibility put upon him, I think it would be a much better plan.

14,289. (*Chairman.*) You want to do away with the Committee altogether?—I think so, certainly; supposing always that I am at liberty to replace it according to my own conceptions of what is best.

14,290. (*Professor Huxley.*) But there are other modes in which a scientific discussion of the results might be attained. Suppose, for example, that the Committee has it in its power to employ a scientific man, and to pay him, in fact, for discussing the observations and making the best that could be made of them, do you think it desirable that the Committee should be empowered to do that, and have funds to do it?—That would be an improvement upon the present system, that is to say, it would be an extension of the present system. It would add to the power of the Committee of doing what is useful; but I am not prepared to say that I think that a committee or a board is at all a desirable sort of body for the management of that sort of work. You get much better results by imposing individual responsibility. There are certain functions which committees and boards may exercise usefully; but I do not think such bodies are what is wanted in the present case. I think that you ought to have somebody who takes in the whole matter and the whole subject which is to be dealt with, and views it as a whole, and thinks of it as a whole, and deals with it as a whole.

14,291. You would put at the head of it somebody who should occupy the same sort of position with regard to meteorology, as the Astronomer Royal does with regard to astronomy?—I think so, certainly.

14,292. And you would let him make the best scientific use of it that he could?—I think so. But the practical difficulty in the way of starting a system of that sort is the fact that meteorology is in such an extremely immature condition, that I do not know that one could very readily find anybody who would be the proper man to put at the head of such an institution, because if large sums of money have to be spent, there is great responsibility resting upon the individual, whoever he is. If the money is spent improperly it is perfectly certain that the public will eventually find out that the money is so spent, and that will have the very worst result in the future as to getting similar grants of money hereafter.

14,293. So that on the whole possibly it might be the safest to keep to what exists?—My impression is

Maj.-Gen. R. Strachey, R.E., F.R.S.

28 April 1874

that what is actually wanted to begin with, for I think you must start with that, is an expression on the part of the Government or of the public that it is desirable to do more for the support of this branch of science. And really until that sort of feeling is established, as I said before, it is almost impossible to devise a scheme by which the thing could be done. It is a waste of trouble to propose or to think about it, if you know that the thing is not going to be done. Then I think that if the Government is going to spend increased sums of money on scientific objects, including scientific research, it is absolutely necessary to establish some proper controlling body, and that is the main difficulty. The main difficulty in all these things, when you go to the bottom of them, is the supervision or control, and what is wanted, therefore, is to have an organisation which shall secure the reasonable application of whatever funds become available to the ends to which it is desired to apply them. In this view some such body as has been talked of, a scientific council of some sort or a commission, acting under a recognised scientific public department, would probably be the most suitable to exercise a control over the heads of the various establishments, who would otherwise be left reasonably free to carry out their own views as to how their operations should be carried on.

14,294. (*Chairman.*) I gather that you would not think it advisable to change the present system, unless something much more extensive is aimed at by the Government?—That is my impression. I do not see myself that you could hit upon a better plan. I think there is something to be said in favour of the present system. It is not a very brilliant one, but still it is pretty good.

14,295. Should you like to have the funds at your disposal increased?—There is no doubt that if the funds were increased, and greater breadth could be given to the operations of the Committee, useful results would be produced. I think there is no question of that, but I confess that my own feeling is that what is specially wanted is that more should be done in the way of *bonâ fide* cultivation of the scientific part of meteorology, which up to the present time has hardly been touched.

14,296. Then you do not think that the Meteorological Committee, upon the whole, have done much for the advancement of meteorological science?—No; they have been collecting facts, but that is a totally different thing from deducing scientific results from facts.

14,297. Do you think that it is of great importance that attention should be directed to the natural agencies the operations of which are known as those dealt with by meteorology?—Certainly I do.

14,298. Can you give any illustrations of your opinion?—I have long thought, as I have mentioned before, that India was a place where meteorology might be studied with particular facility. Further, the experience which may be got there affords a most excellent proof of the vast practical importance of the appreciation of the physical causes which bring about meteorological phenomena. There is no question whatever that the great extent to which famines have prevailed in India, and the frightful results which have followed from them, have been to a considerable extent the result of a want of appreciation on the part of the Government of the fact that the droughts which cause famine occur according to a natural law, and that they are in reality the necessary consequences of the climate of India. If the Government had appreciated that fact as they ought to have done, and as various people have been trying to make them appreciate it for a long time past, they would have perceived that the only way to prevent famine consequent on drought is to supply that which is lost by the failure of rain, that is to say, to give water to the country; to provide the means of artificial irrigation, thing which has not yet been done otherwise than very imperfectly. The Government has gone on from year to year, seeing one famine succeed another, and as each one has come to an end they have hoped that it will be the last, and that another will not come. On such occasions as these a difficulty often arises, which has been felt at the commencement of the present drought, namely, that the rain fails over a large area, and it is not known where the worst results are to be anticipated, for the reason that the meteorological data that are collected are extremely scanty. The registers of the rain are very imperfect, and they are not put together with sufficient accuracy or with sufficient promptitude. Thus the fact that a drought is about to occur is not appreciated thoroughly and properly until the famine is actually upon the country. There is no question at all that the incompleteness of the meteorological records in India has in all cases aggravated the difficulties which have had to be contended with.

14,299. Is it not as much from unwillingness to be at the trouble and expense as from actual ignorance; because if they were asked, would not those who are concerned in the Government of India admit that in all probability there would be a famine there every few years?—I have been trying to persuade them for a great many years past that there is one remedy, and only one.

14,300. Do you think that means might be taken to prevent the recurrence of the famines?—Nothing could prevent the recurrence of the drought and the failure of the rains.

14,301. But could not sufficient water be stored to prevent the evil effects of the drought?—The fact of course is, that famine is the result of the want of food, and the want of food may be remedied in two ways; one is to supply the water which is necessary to secure the production of the food, and the other is to bring food to the place where it is wanted from other parts of the country. I think there is no year in which India, if it were left to itself, would not be able to supply itself with food, as a whole. Thus there are two classes of remedy. One is the provision of irrigation works, which will secure the largest supply of food that is possible; and the next is, the improvement of the means of communication, so as to provide the means of bringing the food to the places where it is wanted at the proper time. What has happened in this particular year in northern Bengal is the failure of rain, to begin with, and the consequent failure of the food produced there, combined with difficulties in the way of getting food there from other places. It was exactly the same in Orissa. In Orissa in 1866 the failure of the means of transport was, unfortunately, very much greater, and the people were starved because it was impossible to take the food to them. Fortunately, on the present occasion we have a railway which runs right through the heart of the country where the drought has occurred, and we have had unlimited means, so to speak, of taking the food within reach of the distressed districts; and in proportion as the means of distributing food are improved, so will the means of coping with famine be improved. The fact is, that England, as regards its locally produced food supply, is infinitely worse off than any part of the country which is now suffering in India; and the only reason that England does not suffer from famine year by year, is that it is a civilised country, and that the other is a barbarous one. The condition of every country that is in a state of barbarism is one of periodical famine. Of course there are various other things which aggravate these Indian famines, of which the enormous population is one.

The witness withdrew.

Adjourned to to-morrow at 12 o'clock.

No. 6, Old Palace Yard, Westminster, Wednesday, 29th April 1874.

PRESENT:

HIS GRACE THE DUKE OF DEVONSHIRE, K.G., IN THE CHAIR.

The Most Hon. The MARQUESS OF LANSDOWNE.
BERNHARD SAMUELSON, Esq., M.P.
WILLIAM SHARPEY, Esq., M.D., F.R.S.
HENRY JOHN STEPHEN SMITH, Esq., M.A., LL.D., F.R.S.

A. Buchan, Esq.

29 April 1874.

ALEXANDER BUCHAN, Esq., F.R.S.E., further examined.

14,302. (*Chairman.*) I believe it is about two years ago that you were so good as to give evidence to the Commission respecting the Scottish Meteorological Society: are there any other matters connected with its operations to which you think it desirable to call the attention of the Commission?—Yes, there are a few points which I wish to bring before the Commission.

14,303. We shall be very glad to receive any information which you wish to lay before us?—An inquiry into the relations of the migrations of fishes, particularly those of the herring, to sea temperature, winds, and weather generally was undertaken in 1872 at the suggestion of Lord Tweeddale, President of the Society. The inquiry was remitted to a Committee, Mr. T. Stevenson, C.E., being convener. The first step was to enter into communication with the Fishery Board, from whom were obtained the returns of the fishing from four of the district officers for the six years ending 1872. These were discussed, and the results published early in July 1873. From this preliminary tentative examination there seemed to be a connexion between the migration of herrings and the weather, but it was evident that fuller details were required in order to prosecute the inquiry with success, namely, details as to the daily catch at each place, to the daily number of boats out, and the state of the weather at each fishery district. At the suggestion of the Herring Committee, a letter of instruction was issued by the Fishery Board to all their district officers, calling for this additional information, of which this is a copy:—

"Fishery Board, Scotland, Edinburgh,
"SIR, July 16, 1873.

"THE Meteorological Society of Scotland being desirous to make endeavours to solve points relating to the natural history of the herring, and to ascertain more scientifically and accurately than has yet been done the influences which govern the appearance of the shoals of herrings upon the coast of Scotland, have applied for the co-operation of the Fishery Board in this important national matter with a view to the district officers of the board collecting during the herring fishery with care and certainty the information required by the Meteorological Society. This information consists of—1. Daily record of the state of the weather. 2. Daily record of the quantity of herrings caught. 3. Daily record of the number of boats fishing. You are desired, therefore, to get this information during the herring fishery with as much certainty as you can, and render it to me week by week in your weekly returns of fishing. Should you find the ruled spaces of the return too small to give these particulars in the body of it, you must give them by endorsement on the back of the return; and you must make a complete copy of every return in your weekly report book, using two or more pages for the purpose if necessary. You are to understand that the collecting and rendering of these particulars is not to be allowed to interfere with the performance of your regular duties, but it is considered that in the course of those duties you may without much trouble or difficulty obtain what is here called for and render it. You will acknowledge these instructions upon their reaching you.

"I am, &c.
"B. F. PRIMROSE,
"Secretary."

Arrangements were also made for carrying out observations of sea temperature at the surface, and at the bottom, by Her Majesty's cutter, as the vessel sailed round the various fishing grounds. These observations, which were made six times a day, were of a very elaborate character, and show the sea temperature (surface and bottom), the exact position of the cutter, and depth of the sea at the place.

14,304. Is the Fishery Board a Government authority?—Yes, and they have very readily co-operated with us in this inquiry. Mr. Purdie, one of our observers, took the daily temperature of the sea at St. Andrew's, and Mr. W. Boyd, of Peterhead, observed the maximum and minimum temperature of the sea with thermometers continuously immersed. The instructions of the Fishery Board were very completely carried out, and the observations have been discussed. It is of course premature to draw any positive results, but it is interesting to note that such results as were arrived at by the earlier investigation have been confirmed. What is now required is the accumulation and discussion of a few years of such observations taken according to the plan which has been put in operation by the Committee. If the Committee were in a position to supply thermometers to such of the more intelligent fishermen as would use them we think that the inquiry would thereby be greatly promoted. (The mode of discussion was here detailed, and 35 maps were exhibited, on which were shown in red figures, the average number of crans to each boat, in each district, and, in black figures, the number of boats out, the winds at various stations, thunder and lightning, and the barometric pressure; in short each map is a Meteorological Chart for the evening of the day before the boats arrived; in other words, at the time the boats left the ports. Those are all set down here in their places for each day, so that by a comparison of the maps the migration of the fishes from point to point along the North Sea can be traced from day to day in connexion with the climatic conditions.) At the beginning of the inquiry the Committee were convinced of the necessity of fuller and more extended observations on sea temperature being made, and accordingly steps were taken to have such observations made. Those have been commenced according to a plan devised by Mr. Stevenson, by which the daily temperatures, maximum and minimum, have been taken with thermometers continuously immersed. One of these instruments was erected in May 1873, at the suggestion of the Committee, by the Trustees of Peterhead Harbour, who were themselves at the expense of erecting the necessary apparatus. This was done under the superintendence of Mr. W. Boyd, who began the observations in that month. The apparatus for Light Ships (*showing the same*) consists of a cylindrical copper vessel, with holes pierced in it for the greater part of its length. It is to be swung from the light ship, with a weight attached to keep it perpendicular. A maximum and minimum thermometer, specially made by Casella for the purpose, is fixed inside by means of elastic bands and supports, and its bulb being always immersed in the lower part of the cylinder which is unpierced with holes, the temperature, will not be changed by drawing the apparatus up and letting it down in making the observations. We have since applied to various authorities for observations made in this way, for instance, to the Northern Lighthouse Commissioners,

A. Buchan, Esq.

29 April 1874.

but there are some difficulties in the way; to the Liverpool Dock Commissioners who have authorised it, and it is at their expense that this instrument has been made; and to the Trinity House, but we were refused, inasmuch as the Meteorological Office had applied to them, for observations of sea temperatures some time in July last; to the Irish Lights, who applied to the Board of Trade for the necessary funds to pay or the instrument, but were refused. It lies with the Council to meet this expense since the observations must be made entirely through private subscriptions of the members, seeing that the Society has no funds for this purpose. To carry out this inquiry a very considerable outlay will be required for the purchase of the apparatus as well as the discussion of observations, which is of a very laborious nature. If thermometers be furnished to fishermen, it will require to be done by individual members of the Council subscribing.

14,305. Have you raised any special fund for this purpose? If I recollect rightly you stated before that the income of your society was scarcely sufficient for the work at that time in hand?—Not a penny of the expenses will come out of the income of the society, but the expense must be met by individual special subscriptions if the work is to be done by the society at all.

14,306. A certain amount of expense, I suppose, has already been incurred in what you have already done?—The expense of my official time.

14,307. But has there been no expense incurred in these maps?—We have them in the office for these and other purposes.

14,308. Then hitherto the inquiry connected with the herring fishery has not entailed any extra annual expense?—Not as yet, but some expense will be incurred, and some members of Council have promised subscriptions.

14,309. But it has thrown some additional trouble upon you?—Yes. And there are also some additional expenses, such as for the apparatus to be ordered for the Irish Lights, which will be paid out of private subscriptions or out of some fund specially raised, unless the Government assists us.

The next question is the establishment of Storm Stations. These are established with the view of collecting data for the solution of some of the more important meteorological problems, particularly the relation of wind force to barometric gradients Several series of stations are in course of being established, radiating in lines from Edinburgh, at which observations, chiefly barometric and wind, are made only when anything remarkable in the state of the weather or the barometer occurs which strikes the observer as noteworthy. This is the schedule which is to be issued for the purpose of these observations (*delivering in the same*). This inquiry will involve a good deal of expense in the way of reducing the observations, and if we were in a position to supply schoolmasters, clergymen, the smaller class of farmers, or others who might be willing to assist, but who could not be expected to purchase the instruments, we think that we could materially promote one of the most important questions of meteorology, which can only be done successfully through a society with local influence.

14,310. How do you contemplate meeting the expense connected with the establishment of the Storm Stations?—We propose, in the meantime, to secure the services of those who are willing to provide their own instruments, and if any one expresses a wish to aid in the matter, to see if we can raise private subscriptions for the purpose, but of course without some aid from the State the whole of the Society's operations in this direction must be very much hampered. A sum of 30*l.* or 40*l.* a year would be a very great help to procure instruments for the prosecution of this inquiry. In connexion with this subject, returns were obtained from all the Scottish Lighthouses, the Commissioners having, at our suggestion, prepared this schedule (*handing in the same*), which is regularly filled up for the Society. The returns are particularly valuable, especially in connexion with the progress of storms. They record very carefully the fluctuations of the barometer, and the changes in the direction and strength of the wind at the moment of their occurrence. The keepers of the lighthouses being always on the watch, and in positions on the coast which are peculiarly suited for these observations, we think that for the purpose of the examination of storms these are perhaps the most valuable observations that exist, certainly in this country.

14,311. How many stations of this description have you, or are you in communication with?—59. We have not been able to reduce the monthly results, but we have frequently used the observations in special inquiries. We have no funds as yet to reduce and print the results.

14,312. Would the 30*l.* or 40*l.* which you talk of be sufficient to enable you to meet the expense of the reductions?—The 30*l.* or 40*l.* referred to was for the purchase of instruments. For the adequate reductions of these and other observations collected by the Society, two clerks at least are required.

14,313. With reference to the Storm Stations, has the establishment of those stations been undertaken since you were here last year?—Yes; the subject was first proposed at our General Meeting in January last, and it was remitted to Mr. Stevenson and Mr. Hope, of Bordlands, to carry it out. Some time will necessarily be required before the scheme is fairly established, but ultimately we hope to succeed.

The society has established a number of stations in connexion with an inquiry into local climates. At the Bridge of Allan we established two, but unfortunately the observers died within two years after the stations were established, so that it broke down there. We have them established at Aberdour and at Burntisland, in East Lothian, and on Deeside. We have also established several stations on small islands where the influence of the sea is very strongly felt, such as North Unst, Monach, the most westerly point of the Hebrides, Airds, and several other places, and the results we have thereby obtained raise very important questions in meteorology. We find, for instance, that in the month of January the mean temperature of North Unst is 41°·5 which is very nearly that of Ventnor. At Monach, in the west of the Hebrides, the mean temperature in January is 44°; that of Truro is only 43°·7, and of Guernsey 43°·5. This result shows in a forcible manner the extraordinary influence of the sea on the climate of the coast. North Unst and Monach are islands so very small that the influence of the land is scarcely perceptible in its effects on the temperature through solar and terrestrial radiation.

14,314. (*Dr. Sharpey.*) Is not the temperature of the sea higher at the same time?—Yes; but the remarkable result is that the mean temperature at those places is all but identical with that of the sea. At places such as Dunvegan, on the West of Skye which is a much larger island, the mean temperature of January there is about 40°. At Airds, on the coast of Argyll to the north of Oban, much exposed to the currents of the sea, the mean temperature of January is 40°·4; whereas inland on the same parallel of latitude, in the West of Perthshire, it is 38°·5. On the East coast the influence of the sea is also felt, though not in so marked a degree. At St. Andrews, where the observations are made close to the sea near the top of a high cliff, the temperature of January is a degree warmer than it is at a station three miles inland. It is probable that this enormous influence of the sea extends but a very little way inland, perhaps not more than a mile; at least, it is very small further inland.

14,315. Airds is a considerable way inland, is it not?—It is on Loch Linnhe, and the currents which pass and repass there are very strong. It is especially where there are currents, bringing up warmer water from the bottom of the sea, that enormous differences are observed. What the Council propose

A. Buchan, Esq.

29 April 1874.

to do in this matter is, to investigate this singular influence of the sea by establishing stations, one close to the shore, one say two miles inland, and two or three intermediate. I may point out here that after I had published the charts of the isothermals of the British Isles, a few years ago, Professor Hennessy of Dublin, sent me the chart I hold in my hand, which he had prepared for Ireland, showing the isothermals, which, it will be observed, are concentric with the coast, and show a mean annual temperature in the interior of Ireland of 47°. The data from which Professor Hennessy constructed this chart were almost wholly obtained from stations near the sea, with one or two in the interior for brief periods. Hence the lines are drawn correctly for the coast, but hypothetically for the interior. For instance, the annual isothermal of 47° passes through Armagh, but from 13 years' observations which we have from Professor Robinson of Armagh, the annual mean is 49°·6. The annual mean of Athlone is given as 47°, but from observations for six or seven years it is 49°·5. Those general results are applied by Professor Hennessy to the question of flax cultivation. When data are adduced in connexion with important objects of culture, it is unnecessary to say that accuracy is of the greatest importance. The real question is how do the isothermals incurve when they approach the coast? an extremely difficult problem, and one that will take a considerable number of years in working out satisfactorily, viz., by the establishment of stations as indicated above. It is only in this way that the peculiar influence of the sea can be investigated, which has such marked effects on animal and vegetable life, as seen in the distribution of plants, the distribution of diseases, and in the benefits obtained from seaside climates.

14,316. (*Chairman.*) This branch of your operations, I presume, is not connected with any great outlay?—We are endeavouring to get our wealthier members to undertake it themselves under our direction; but it could be done more satisfactorily if the Council were in possession of the necessary funds to enable them to make grants of instruments to those who might be willing to undertake the observations.

14,317. Do you find generally that there are a large number of private individuals who take an interest in inquiries of this kind?—Yes.

The next question is the influence of seasons on human mortality, at different ages, as caused by different diseases. The Council has recently taken up this subject, and they have remitted it to Dr. Arthur Mitchell and myself for investigation. I have brought with me several charts, and I will, as briefly as possible, explain to the Commissioners the object we aim at. We have begun with London, because of its large population, and full weekly returns, and have adopted an average of 30 years beginning with 1845. Averages of the temperature, dew point, relative humidity, and rain have been calculated, and I may take the opportunity of mentioning that the returns, both of the Registrar General and of Mr. Glaisher are singularly accurate. Indeed I know of none more accurate in the main than these. (*Here a large number of diagrams were exhibited in order to show the extensive nature of the inquiry, and the important results already arrived at. These diagrams showed the curves of mortality from many of the more marked diseases calculated from the mortality tables of London, Australia, India, &c.*) What I have now stated will indicate generally the course of the inquiry that we have begun,—an inquiry which involves an immense amount of clerks' work in computation, and considerable expense in gathering information, putting it into shape, and publishing it. Such an inquiry as this is best taken up by societies like ours, it being necessary to its successful prosecution that the investigators be familiar both with the principles of meteorology and medicine, and have the assistance of an office staff for the enormous computations which are indispensable.

14,318. How have the expenses of this department of yours been met hitherto?—Hitherto the money outlay has been small. The outlay has chiefly been in computations, which have been undertaken by myself during ex-office hours, and which are too heavy to be continued without assistance. Considerable expense will be incurred in publishing the results from time to time; in collecting information; in establishing special stations to show the influence of local climates on disease, &c.

The next question that I have to bring before the Commission is agriculture. I need scarcely refer to what the society has done for agriculture during the last 18 years. The Marquis of Tweeddale, President of the Society, has largely assisted the society in this direction, by a number of prizes. The first that his lordship gave was for the best essay on the rainfall of Scotland. His lordship learned, when in India, that the opinion amongst the Brahmins was that there is a periodicity in weather changes, and that this period was about 19 years. One main object of this essay was to inquire if there was in the rainfall a periodicity. This question did not receive an answer until a few years ago, when Mr. Lockyer, Mr. Meldrum of Mauritius, Professor Piazzi Smyth, and a number of other writers took it up, and it has been shown that there is a relation between the sun-spot period and rainfall, and probably other meteorological elements. His lordship also gave a prize in connexion with the profitable or unprofitable culture of farm crops. This drew out eight valuable sets of observations, for which his lordship gave prizes amounting to 40*l.* These observations were discussed, from which it was proved that if the mean summer temperature in Scotland by thermometers exposed to the sun is 58°·5, or by protected thermometers 56°, and the rainfall the average, the heat is just sufficient to ripen wheat and barley. This very valuable result could not have been accomplished by the society, unless his lordship had given us 40*l.* to enable us to carry out the inquiry. His lordship also offered a premium of 80*l.* for observations of the temperature of drained and undrained hill pasture and arable land. The results derived from the observations thus obtained were of very great value with reference to the behaviour of the temperature on drained and undrained land respectively, and were discussed in Volume I. of the Society's *Journal*. The following points were discussed: The effect of a sudden fall in the temperature of the air; the effect of a continual fall in the temperature; the effect of a protracted frost; the effect of a sudden rise in the temperature of the air; the effect of a continuous rise of the temperature of the air; the effect of rain; the effect of sleet; and the effects of a thaw. All these points were respectively taken up and discussed, and the results shown. Then there was an essay on prognostics, for which his lordship gave 20*l.* The last prizes that he gave were on underground temperature, by observations made 12 times a day on pressure, the temperature of the air, and the soil, wind and other elements, and some very remarkable results were deduced from them, which have been published in the Society's *Journal* Volume II., page 276, and Volume III., page 214. The April and October observations are not yet discussed, and a part of the results of July and January also are not discussed for want of a sufficient office staff. Some very interesting results were obtained on other matters than those connected with mere drainage and soil temperature.

The next inquiry was undertaken with the view of disclosing the effects of very exceptional weather on different crops in different localities. An elaborate set of special statistics relating to the yield and other qualities of agricultural crops was recently obtained through the Highland and Agricultural Society of Scotland. Schedules were issued to 40 distinguished agriculturists in all parts of Scotland, who gave returns upon all the different crops in their district. These observations we have not yet been able to discuss. All these discussions and inquiries I have referred to have led the Society, especially the President, to con-

A. Buchan, Esq,

29 April 1874.

sider the effect of solar radiation in connexion with the crops, as perhaps the most important of all to the agriculturist and the meteorologist. I mentioned in my evidence two years ago that Lord Tweeddale had established an apparatus for registering every 10 minutes the pressure, the temperature, and the humidity of the atmosphere, and the rain, specially designed with reference to the relation of solar radiation to the growing crops. These interesting and valuable observations have not yet been discussed. They would be more interesting if we had several such apparatuses in other districts whose climates differ materially from that of Yester in East Lothian where they are placed. In connexion with the subject the Council have instituted other lines of research affecting agriculture. The question of integrating the amount of solar heat is a very important one. It is not pretended to arrive at absolute results, but what the council aim at are comparative results from similar instruments used in different situations. It is done by means of an instrument devised by Mr. Stevenson consisting of a glass ball with a long neck, in which there is a provision for setting the height of the fluid to a particular level, and the out-flow of water during the day is measured, it being filled at 9 in the morning, and then observed at 3 or 4 in the afternoon. It is tentative, but we hope that it will enable us to arrive at what differences there may be in the climates of different parts of Scotland. We know, for instance, that certain crops and fruits can be reared about 700 feet higher on Deeside than they can on any part of the west of Scotland. Oats are reared 1,600 feet above the sea in Deeside and Donside, about Braemar and Strathdon, but at heights in the west several 100 feet lower they are only grown for the sake of the straw. We wish to arrive at what is the cause of this.

The Society undertook some observations in connexion with ozone by means of aspirators. The expense of those aspirators was borne by Lord Tweeddale. A number of other inquiries regarding ozone were suggested, and his lordship recently gave the Society 100*l.* to work out this subject, and this winter, through the Ozone Committee, Professor Andrews of Belfast, delivered an address upon the subject to the Royal Society of Edinburgh. This address is being published in the Society's *Journal*, and the expense connected therewith is defrayed by his lordship. The inquiry is in progress, but so far as this subject is concerned we have the funds to meet all that we require through his lordship.

14,319. Apparently without his assistance a great many of those inquiries could not have been undertaken ?—No, we could not have undertaken some of the most valuable work that we have done. The definite conclusions which we have arrived at, for instance, the conclusion with reference to the temperature required for crops I think has influenced considerably the practice of agriculture. Of course, other influences, such as the price of butchers'-meat, have been at work, but the farmers know well that the temperature of the North of Scotland is within 2°·5 or 2°·0 of what is essentially requisite to ripen those crops, and they know that a very little below the average means disaster.

In the evidence which I last submitted to the Commission, I stated that we often supplied information to foreign meteorologists, and that we did this so far as we could, but that it threw a great deal of work upon the Office; since then the American Government, through General Myer, who has charge of the Meteorology of the United States, has proposed a scheme of International Meteorology, by which observations over the northern hemisphere or over the whole globe are to be made exactly at the same instant of time, and our co-operation was asked. We supply them with observations from 14 of our stations, and it is very desirable that we had some more assistance to enable us to help in this inquiry. What the Society would wish to do in connexion with their daily observations is to have the means of publishing a selection from them for distribution amongst foreign meteorologists, just as we receive from these foreign meteorologists, the published observations which their governments enable them to publish.

14,320. (*Dr. Sharpey.*) What would be the expense of that ?—I should think about 50*l.* or 60*l.* It would depend entirely upon the number of stations embraced. Many of our stations are in such important positions that we are constantly being asked for copies of the observations. As respects Meteorological Congresses, our Society was enabled to take part in them through the liberality of individual members of the council. We were invited to them; but as the society had no funds for the purpose, individual members of the council contributed, and sent me both to the Conference at Leipzic and to the Congress at Vienna. It is most desirable that the Society were in a position to take part in any such congresses as may be held in the future. I may also mention that the Society has since its origin supplied to the Registrar General for Scotland observations from 55 stations, and up to this time we have received no pay for this work.

14,321. What is the nature of the information which you supply to the Registrar General ?—Observations of the barometer, maximum and minimum thermometers, wet and dry bulb thermometers, wind direction and force, rainfall, clouds, temperature of the sea, temperature of wells, ozone, &c.

14,322. (*Chairman.*) Do you know whether it is much of the same nature as the information which is supplied to the Registrar General of England through Mr. Glaisher ?—Of much the same nature.

14,323. Are those reduced returns made quarterly, or how ?—Weekly and monthly. Professor Smyth has done his part of the work more than well. He has gone *con amore* into it, and done it in a much fuller manner than was required by the agreement.

I had a conversation on meteorology generally with Professor Balfour Stewart, who explained his views to me with reference to the division of meteorology into what he calls Physical and Climatic Meteorology. I communicated the result of the conversation to Lord Tweeddale, and his lordship wrote to me, strongly approving of the view of dividing meteorology into physical and practical or climatic, so that purely physical inquiries are remitted to large, well equipped observatories, such as Greenwich or Kew, and observations of meteorology which bear upon health, agriculture, commerce and other interests to societies such as ours. This division of the subject has special reference to the purposes to which the grants from Government are to be applied by the different bodies. A good deal of the evidence which I have given to-day regarding local climates, the influence of the sea, and of exposure, the relation of different meteorological conditions to the herring question, and the question of storm stations come under the head of practical or climatic meteorology, and can only be effectively worked out by a society that has great local knowledge and influence.

Among questions of a general character, I think one of the most important and imperative is that of solar physics, particularly the observation of sun-spots. We know now, especially from Mr. Meldrum, Mr. Lockyer, and others, that the rainfall of the tropics, and generally of the whole globe, is connected with the sun-spot period. Professor Balfour Stewart stated to me that during the maximum sun-spot period the actinic rays of the sun were feeblest. If this opinion be correct, its bearing on questions affecting health and mortality is evident.

About 10 years ago Professor Poey made a series of valuable observations in Cuba, on the temperature of the sky at different angles from the horizon by means of the thermo-electric pile, and obtained some remarkable results, showing that it was much greater at certain heights than at others. The relation of these results to the whole question of terrestrial radiation is of the greatest importance, and if we had exact and fuller information upon this subject from British and other observatories it would tend greatly to the solution of many questions con-

A. Buchan, Esq.

29 April 1874.

nected with terrestrial radiation. He also examined the temperature of clouds of different species and at different heights, and found that the cirrus cloud was the coldest, and that the cumulus, except in certain conditions, was the warmest—thus opening up a line of inquiry which properly falls to be worked out by a physical observatory established for the prosecution of meteorological inquiries.

Our information regarding the vapour of the atmosphere as a radiant and absorbent of heat is very defective, and extensive experiments and observations connected therewith are urgently called for. At present observations on atmospheric vapour are almost universally made by wet and dry bulb thermometers, and the results arrived at regarding the dew-point, the amount of vapour in the atmosphere, relative humidity, &c., are in this country deduced from Glaisher's tables. Now these and all such tables are in an unsatisfactory condition. For Great Britain, with the usual temperature and states of the atmosphere, the tables are fairly good, but in spring in cases of great heat and great drought, the errors are considerable. As regards such hot climates as north-western India, if hygrometric observations made there be reduced by Glaisher's tables, and also by formulæ in accordance with the results obtained by Regnault's recent researches, we obtain from observations of the same air two dew points, which may differ to the extent of 25°·0 from each other. Such being the present state of our hygrometrical tables, it is plain that meteorologists are not in a position to investigate with the requisite accuracy this important element of the atmosphere upon which the whole problem of meteorology turns. It is by the vapour of the atmosphere chiefly that the equilibrium of the atmosphere is disturbed, and it is by the concentration of aqueous vapour over some limited region that hurricanes and storms in all probability originate. Extensive observations on the dew-point with Regnault's hygrometer in connexion with the different hygrometers in use, are required, from which tables may be prepared sufficiently trustworthy and complete for the reduction of all hygrometric observations. Let it be well understood that till this be done, many of the most important problems of meteorology cannot be properly discussed.

14,324. (*Dr. Sharpey.*) To whom would you go for a solution of those questions ?—The work cannot be done but at a fully equipped physical meteorological observatory, having at its head a competent scientific man who is provided with funds by the State for carrying on the extensive observations required.

14,325. Then, if I understand you rightly, you would assign to a central establishment engaged in researches in physical meteorology, the determination of those points that you speak of as to the proper methods of inquiry respecting the atmospheric moisture and the like, which might afterwards be applied by local establishments ?—Quite so.

14,326. So that physical observatories would supply methods for the work of climatic meteorology ?—Yes, and supply us with the requisite instruments for the purpose,—using the word instruments in its broadest sense, as including tables, and so on. I think also that it is most desirable to investigate questions of radiation and absorption through the pure gases of the atmosphere as well as aqueous vapour. As regards anemometers, I believe I am correct in saying that we have at present no velocity anemometer (Robinson's, for instance) whose indications we can value, feeling assured that they are correct, and give truly comparable indications, and which when erected at a station admits of its error being at any time ascertained. This state of things ought to be rectified; and can only be rectified by a properly appointed physical meteorological observatory. When the indications of a pressure anemometer are examined, it is seen that the wind is far from being a steady blowing current, it oscillates from a pressure of, say, 20lbs., to a pressure of 40lbs. almost instantaneously. During storms the chief feature of the wind is its gusty character, and the strength of these sudden gusts no velocity anemometer can measure. Now it is the force of these gusts regarding which correct information is most sought after by seamen, engineers, &c. No observatory that attempts to record wind observations can be considered as completely equipped unless it has a pressure anemometer which can be compared and verified, and its error ascertained at any time. Another important question is the determining of the conditions of a good position for an anemometer, so that the indications will give a tolerable approximation to the real direction and force of the wind over the place. The influence of the land in deflecting the wind from its true course is very remarkable, the deflection from its normal direction amounting in some cases to fully 90 degrees as it rounds the ridge of a hill or is deflected by the contour of the land. Thus at Liverpool the general direction of the wind is west-north-west, instead of west-south-west, the general direction of the wind in that part of Great Britain. With regard to the dragging effect of the land and other objects on the wind, if a wire screen with meshes an inch apart be placed against a wind, flower pots placed on the lee side of it during a storm are in calm. From this it will be easily understood that the velocity of the wind is enormously different at different heights above the ground. The rate of increase in the velocity as we ascend from the ground we are absolutely ignorant of, so that it is at present impossible to attempt, by means of any anemometric observations, to arrive at an approximate indication of the true velocity of the wind over any place. What is imperatively required is experiments by a series of anemometers placed at different heights in the same place, in order to ascertain the dragging effect exercised by the earth's surface upon the wind,—an inquiry that can only be satisfactorily carried out by a physical observatory, owing to the expense. We cannot at present, from any wind observations that have yet been made, draw any conclusions regarding the general rate of movement of the atmosphere. Conclusions of tolerable correctness can only be drawn as regards direction, and no more can be attempted owing to our ignorance with reference to this important question.

Our Society has worked a good deal at the question of the temperature of the soil at depths of 3, 12, and 22 inches. Our thermometers are fixed in the ground. Continental meteorologists use Lamont's method of observing earth temperatures, which consists of a wooden tube, down which the thermometer is sunk, and up which it is drawn when an observation is made, at all depths exceeding 3 inches. A series of experiments in connexion with this subject are called for in order to ascertain the value of each of these methods of observations.

Another important question is the true observation of the air temperature. We are not now in a position to say that any temperature observed by the methods in present use is the true temperature of the air at the time of observation. How to eliminate the effects of radiation of surrounding objects from the temperature observations is one of the most important questions of physical inquiry. It will be necessary that boxes for the thermometers of all sorts as regards material, size, and pattern, be erected, in exactly similar positions, in which temperature observations may be made, and compared with observations made at the same time by Joule's method of observing the true temperature of the air* at all hours of the day and in all seasons of the year, for a series of years. From the results so obtained we should be in a position to say what sort of thermometer box is the best for giving an approximation to the true temperature of the air, and is easily observed with at stations of the second order. In Russia, Switzerland, and some other countries, zinc boxes are used because they are believed to follow more closely the fluctuations of the temperature of the atmosphere. In this country wooden boxes are

---

* Described by Dr. Joule in a communication to the Philosophical Society of Manchester, 26th Nov. 1867.

A. Buchan, Esq.

29 April 1874.

used. The Glaisher stand is open to the north, the stand used by our Society is louvre boarded all round; some again have louvre boards on the bottom of the box, some have not, and so on. In Scotland we have from the beginning attempted to secure uniformity in the methods of observation at all our stations; we have insisted upon this in order that the observations at the different stations may be comparable *inter se*, which is all that can at present be secured.

Another important question is that of evaporation, which concerns the drying qualities of the air, and which is so important in connexion with health, and with all questions affecting animal and vegetable life. A little has been done in this direction, but we are still far from being in possession of instruments that give comparable results. The question is one for physical observers to examine and inquire into by means of observations and experiments extending probably over some years.

The extreme desirableness of regularly observing the electricity of the atmosphere has been frequently under consideration by the members of our council, but nothing has been done owing to the great expense attending such inquiries. The subject is so important in many inquiries (with the herring question, for instance, it has a remarkable connexion), that it should be taken up by a physical observatory, with a view of devising some inquiry that could be turned to account at secondary stations.

Another duty of those physical observatories would be to institute observations by which an exact value could be put upon observations like those made at such stations as ours. That could be done by apparatus exactly similar to ours being established in close proximity to the instruments at the physical observatories; in this way much might be done in valuing observations of temperature, humidity, wind, and rain.

There is another matter which our Society has done a good deal in forwarding, and which was recommended to be carried out as far as possible by the late Congress at Vienna, namely, establishing stations in foreign countries, at places of great importance, where there is no likelihood of any local means being taken to establish stations. We have established stations in the Faroe Isles, in Iceland, at Jerusalem, in Cyprus, at Damascus, Beyrout, in Yanina, Nice, Pau, and also in Brazil. At the time that we established those stations there were none in those places or near them. The instruments were supplied to these stations not from the funds of the Society, but through special contributions or otherwise.

14,327. (*Chairman.*) Are you acquainted generally with the operations carried on under the direction of the Meteorological Committee?—Yes, generally.

14,328. Are you prepared to express an opinion as to the value of what has been done under its direction?—I think the barometric observations possess great value; taken all in all they are the fullest that we have.

14,329. Is that work which otherwise would not have been accomplished if the Government had not provided the means for carrying on those observations?—It scarcely could have been accomplished in so complete a manner. Lord Tweeddale has observations of pressure made every 10 minutes by means of a self-recording instrument. Abroad, the observations of pressure are generally made by means of an aneroid barometer, which is self-recording, at stated intervals such as every hour, alongside which there is a standard barometer which is read several times each day, and the readings of the aneroid are corrected by means of these eye observations. That is not so satisfactory a method, but it is cheaper.

14,330. At how many stations are the barometric observations carried on?—There are seven in the United Kingdom, three in England, two in Scotland, and two in Ireland.

14,331. (*Professor Smith.*) Are they all self-registering?—They are all self-registering by means of photography, and they may be considered as self-registering every three minutes, that is to say, the breadth of the line of light is such that it takes about three minutes to pass, so that if we were to suppose a fluctuation extending over a minute it would not be recorded. The wind observations I consider also to be good, qualifying the statement by what I have already said about the present state and position of anemometers. The temperature and hygrometric observations are, so far as the instruments themselves are concerned, good. They show great skill in the devising of the apparatus, but as regards the position of the instruments they are bad. It was essential, in such a system, to place the instruments in positions at each observatory, perfectly comparable with those at the others—comparable both as regards height above the ground, and comparable as regards the buildings to which they were attached. In neither of these points have the conditions been attended to. At Armagh the height is 4 feet above the ground, at Aberdeen it is 41 feet, and the result is that at Aberdeen the daily range of temperature as recorded by the thermometers at a height of 41 feet above the ground is only about two thirds of the amount of the range of the district. That is to say, the thermometer of the Meteorological Committee records a range, speaking roughly, of 10°·0 instead of 15°·0. One of the objects, if not the chief object, of establishing those stations was to give thermometric constants. Now, it is plain that the constants deduced from the observations made by the thermometers of the Meteorological Committee are of no use for our stations, inasmuch as the daily range falls short of the true range of the locality by, in the case of Aberdeen, one third of the whole amount. That I take to be the mistake made in the arrangements at those stations, especially of the station at Aberdeen.

14,332. Has the choice of position been left entirely to the observer at each station?—I do not know. But I should scarcely think so. Of course the Meteorological Committee are responsible for the position adopted.

14,333. Do you know whether this point to which you have alluded has been overlooked by the Meteorological Committee?—It must, I presume, have been overlooked at the time of founding the stations.

14,334. Do you not think that their attention has been called to it, and that they do not consider it of sufficient importance?—I believe they have been aware of it for about three years at least, but no change, so far as I am aware, has yet been made. We have not specific information as to the positions of the thermometers at their telegraphic stations, which are more numerous. They have not published a description of the positions of the thermometers, but it is believed that the arrangements are in some cases faulty, and that uniformity is not attended to; and they have not yet published a single monthly temperature average from any one of those stations. Under the management of the Meteorological Office previous to 1867, many of the thermometers at the telegraphic stations were in bad positions. However, in this, as in some other countries, the exigencies of the telegraphic stations may sometimes render the choice of good positions for the thermometers and the rain gauge difficult. It need scarcely be added that results obtained from instruments placed under different conditions are unsuited for inquiries into the relations of weather to health, agriculture, and other public interests where comparability is the first requisite.

14,335. (*Chairman.*) Are there any other points connected with the operations of the Meteorological Committee to which you would like to call attention, for instance, have you referred to their financial statements?—Yes, I have necessarily had my attention in some measure directed to this point.

14,336. Do you consider that the country gets good results from the 10,000*l.* that is expended?—That adequate value is got is, I think, doubtful. The 10,000*l.* might perhaps be spent in ways that would promote meteorology more effectually.

14,337. Is there any particular point upon which you would wish to make any remark as to the details

A. Buchan, Esq.

29 April 1874.

of the expenditure?—I am not sure whether it has been put in evidence by our Society, that during the management by Admiral FitzRoy we were in a very good position for receiving from the Government any instruments we might require, but on the accession of the present Committee we were informed that no more could be given to us on loan, or in any other way.

14,338. By far the largest item in the whole of the expenditure is the expenses at observatories, 2,613*l.*; have you formed any opinion upon that item of expenditure?—The details are not given in the annual reports.

14,339. Are you able to conjecture how the expenditure arises?—There is a skilled photographer required, and I believe the hourly observations are converted into figures at the observatory, from the curves of each day. I suppose that the chief expense consists in remunerating the gentleman at the head of each observatory, who is required to find a photographer and computer. It is a question for consideration how far eye observations, which would cost less, might not furnish the information required. I refer to eye observations such as those that were made for the Russian Government by Kupfer, or those now made at many foreign observatories in connexion with less expensive self-recording instruments.

14,340. Would it in all probability be much less costly?—I think so.

14,341. Is there any branch of their operations, the advantage of which appears to you to be questionable?—I should be inclined to agree in the main with Professor Balfour Stewart, that their attention should be chiefly given to physical researches in connexion with meteorology, and that the investigation of the science in its bearings on health, agriculture, and other practical matters such as those I have already referred to, should be remitted to such societies as ours. If, in prosecuting the practical inquiries which can best be done by societies, there be a tendency on the part of the Office to draft in amongst their observers the observers of other societies, the result would certainly be, if allowed to go on, to extinguish these societies. When observers work for private societies, the work is done cheaply, but when they work for the Government and know that the Government cannot do without their services, it comes naturally to be a matter of considerable expense. It is a question for consideration how far maritime meteorology should be included in the same office as land meteorology.

14,342. Could it in your opinion be possibly undertaken by private societies?—No, it could not be undertaken by private societies, it must be by a Government office. It is a question as to whether it should be undertaken by a distinct office jointly under the Board of Trade and Admiralty

14,343. (*Mr. Samuelson.*) How does that question arise in your mind? What gave rise to that question?—The question was discussed at the Congresses at Leipzic and Vienna. At Leipzic the opinion was expressed that there should be either a separate office for marine observations, or that in the central meteorological office there should be a separate department with a separate head; and at Vienna that marine meteorology might be placed under the general management of the chief Establishment of the country. The question is an important one, but at the same time one of considerable difficulty, the object desired being to enlist to a greater extent than hitherto the services of the Navy, since many questions of ocean meteorology can only be adequately carried out by the Navy. One of the most important practical questions in connexion with ocean meteorology is the determining of constants for the ocean, undoubtedly the most important of which are the daily range of atmospheric pressure over the sea, and the daily range of the temperature of the air resting on the sea. Those are most important questions, and, until we have some approximate solution of them we cannot properly discuss ocean statistics, inasmuch as the observations are made at hours which do not give the mean pressure, temperature, and humidity of the day. And, moreover, since in most cases the observations from which ocean charts must be drawn are so very few, it is clear that until we are able to apply approximate constants, the results obtained will be unsatisfactory. The organising of a system of hourly observations could be carried out more systematically and completely by the Navy than by mercantile vessels.

14,344. (*Chairman.*) Would it be necessary for this purpose to equip and send out certain vessels expressly for the purpose, or do you contemplate it as part of their ordinary duties?—Part of their ordinary duties. I may mention that Professor Wyville Thomson consulted us about sea observations in connexion with the *Challenger*, and the result was that he organised a system of meteorological observations that will partly meet what has been suggested.

14,345. If the views of Dr. Balfour Stewart, in which you have expressed your concurrence were adopted, would any considerable proportion of what is now expended under the head of land meteorology be abandoned by the Meteorological Committee?—There might be a saving as regards inspection of stations, if suitable arrangements could be entered into by the different offices, and probably, also, as regards computation. The work of the Meteorological Office might be re-organised, so that the observations of land meteorology would probably be conducted on a less expensive system.

14,346. Altogether there is nearly 2,330*l.* expended in computations?—Yes, the computations occur thrice in the accounts, under land and ocean meteorology; and the sum appears to be large.

14,347. (*Professor Smith.*) Have any researches in physical meteorology of the kind to which you have been referring been undertaken by the Meteorological Committee?—I am not aware of any.

14,348. Do you know of any improvements in the means of observation or in meteorological instruments that have originated with them?—Yes. I believe they have originated improvements in the system of continuous observations by the photographic process, and in the instrument for recording the rainfall.

14,349. (*Mr. Samuelson.*) Assuming that more were done by the Navy in the way of meteorological observations, would not it still be desirable that the schemes of observations should be settled by the Meteorological Committee, and that the results should be referred to them?—I suppose that would be desirable, but the question is who should control the system.

14,350. You mean whether the Navy would be allowed to accept directions from the Meteorological Department?—That is the practical difficulty, the difficulty of the two departments working harmoniously, and it is to secure the active co-operation both of the Navy and Mercantile services that the question, as to whether there should be two distinct offices, becomes a matter for consideration.

14,351. You have upwards of 100 stations, have you not?—Yes.

14,352. I think you stated in your previous evidence that you did not give any subsidies to these stations? We have never done so. I believe that a few of our members, chiefly landed proprietors, have done so.

14,353. The gentlemen who make those contributions are members, are they not, of your Society?—In all cases.

14,354. What means have you of ascertaining that the regulations which you have laid down in regard to the system upon which the observations should be conducted are carried out?—Partly by inspection, which owing to the want of funds is far from being so efficient as we should wish, and by repeated examination of the schedules. Occasionally members of council, when they are in different parts of the country where the observers are, visit the stations and report regarding the instruments and the method of observing. We feel strongly the want of adequate inspection. As stated in my last evidence (under Qu. 12,394), various

A. Buchan, Esq.

29 April 1874.

things are done by personal investigation to make up for what we have always admitted to be an inadequately performed part of the Society's work, owing to the expense. Dr. Arthur Mitchell and Mr. Robert Tennant and others of the council have visited several times a number of the outlying stations.

14,355. Have they made any report to you officially, or otherwise?—Yes, they have made reports both written and oral.

14,356. What has been the general result of those reports?—That generally the instruments were correct. From the means taken to check the returns by the construction of charts, serious errors are detected and rectified.

14,357. The error would be obvious?—Yes.

14,358. Supposing that these observations were conducted by a Government department at a much smaller number of stations (say, for the sake of argument, 20 stations instead of 100), do you suppose that the inspection could be conducted without expense?—It could not. It is necessary to take a mercurial barometer (an aneroid being insufficient), standard thermometers, and instruments for comparing rain gauges. A good deal of time is required, say from three to five hours at each station.

14,359. If it were stated by the department that they had a sufficient staff of computers in their office, and that, therefore, no expense would be incurred by their assuming those observations, you would say that they had only looked at one side of the question?—Yes.

14,360. Assuming that the Government department were to state that they could take over the climatic observations, and that they could do so without expense, because they had a staff of computers in the house to whom they would make no extra payment, would you consider that that would be meeting the whole question?—It is a mistake in various ways. If the computation be done without charge, it could only be by other departments of the work of the office suffering. Besides, 20 stations are altogether inadequate. I have given evidence to-day with regard to prosecuting many important meteorological questions of a national character, for which our 100 stations are too few. We not unfrequently find that in attempting to investigate important points which rise up, we have too few stations. I have already expressed my opinion that returns from the telegraphic stations of the Meteorological Office are not generally suited for the requirements of the Registrar General and other public interests. (See Qu. 14,334.)

14,361. That is to say, that observations at a great number of different stations are essential, and that inspection is required at all those stations?—Yes, at all the stations.

14,362. And that inspection could not be carried on without some expense in addition to the expense of the mere office work at head-quarters?—It is quite impossible. One, or certainly not more than two stations a day could be overtaken, owing to the tedious work of comparing instruments carefully. It takes from three to five hours at each station, which with travelling is a good day's work. Inspection means not only comparing instruments, but spending some hours with the observer, inasmuch as in not a few cases he requires further education, and the inspector requires to know what value he puts upon various phenomena, so that there may be comparability among the observations of the different observers.

14,363. How often would you say that each station ought to be visited by an inspector?—At any rate every two years, but if possible every year.

14,364. Does it occur frequently that people get tired of the work of observation, and a change takes place in the observer?—Only in the case of a few of those who have had the work imposed upon them, not from any liking to it, but because their employer required them to do it. In almost all cases the interest of the observer in the work increases, and frequently he undertakes additional observations. Indeed we have every year to refuse a considerable number of applications from persons who express their readiness to observe, provided they are furnished with the requisite instruments.

14,365. Assuming that it is desirable that there should be a certain department for meteorology, what should you say would be the most desirable control for that department? Would you put it under a single head, or under an unpaid committee with a director or an equivalent officer?—Under a paid Committee with a secretary, nominated by the Government and consisting of men who possess the requisite knowledge of the subject, the Committee being, in some respects, similar to a Royal Commission. My opinion is that an unpaid committee is not a suitable body.

14,366. You mean that you want to have a Royal Commission for Meteorology alone?—Perhaps I have not expressed my meaning clearly. I mean that whatever committee is appointed, its members should be paid according to attendance, in the same way, for instance, as bank directors are paid, and therefore feel their responsibility.

14,367. But would you have that paid committee a committee for meteorology alone?—Yes, for meteorology alone. Perhaps the word committee scarcely discloses what I mean; it would more correctly be expressed if I used the phrase a Body of Directors appointed by the Government.

14,368. Would you prefer that to having a single head?—The business of the Scottish Meteorological Society has been conducted very satisfactorily by a council elected from the members; it must, however, be added that the members of council are elected because it is known that they are specially interested in the subject. But the central office for meteorology, which would be wholly, and necessarily liberally supported by the State, should be placed under a Minister of Public Instruction, who would be responsible to the Government for the department.

14,369. In that case would you prefer a Commission or a single head under the Minister of Public Instruction?—Owing to the local knowledge and influence which is so necessary in conducting the work of societies, I should prefer a Council for them, but for the Central Department I am of opinion that it should be placed under a paid body of Directors appointed by and responsible to a Minister of Public Instruction, or the Board of Trade.

14,370. Do you not think that a divided responsibility of the members of a committee or a commission, whether paid or unpaid, is in some respects an evil?—That is a question on which I have some difficulty in expressing an opinion. If I mistake not, it is only in some respects that it is an evil. In the conducting of scientific societies and commercial undertakings, experience leads to the adoption of such a machinery as I indicate. A paid small committee representing physical and practical meterology would be invaluable as responsible advisers to the secretary, whose responsibility, his position, and scientific reputation sufficiently secures.

14,371. But not being certain of that, you would prefer a single head, if you could be certain of obtaining a person thoroughly qualified for the post?—Yes, if such were obtained. But the scheme I recommend would, I think, be safer.

14,372. (*Chairman.*) Are there any other matters upon which you would like to add to your evidence?—No; I am not aware of any.

14,373. In your answer to Mr. Samuelson, just now, I understood you to say that if you discontinued making the returns that you now make to the Astronomer Royal for Scotland, and if the Meteorological Committee took upon themselves to obtain those returns, you think that they could not be obtained without putting the country to considerable expense?—I believe not. Besides, the Scottish Society has a proprietary right in the stations which it has established at so much expense and labour, and with these stations the Meteorological Committee cannot interfere, an arrangement to that effect having been entered into last year between the two bodies with the concurrence of the Government. Our Society is perfectly

A. Buchan, Esq.

29 April 1874.

distinct from them, and they are distinct from us. The Meteorological Committee would therefore require to be at considerable expense in founding new stations, and in paying the observers, who could not be expected to observe gratuitously for a Government office.

14,374. Are you in frequent communication with the Meteorological Committee?—We have occasional, not frequent correspondence with the Committee.

14,375. Can you explain what you mean by the sum invested by the Meteorological Society of Scotland?—Large sums of money have been sunk by the Society in establishing the stations, in purchasing instruments, furniture, books, schedules, &c., and otherwise in founding the Society, which possesses upwards of 100 stations, and consists of 560 members, of whom, it is to be observed, 97 are life members, and therefore have a pecuniary interest in the continuance of the society. With regard to 20 stations being sufficient, 70 stations, well distributed, at least, are necessary to represent the general climatic condition of Scotland, not taking into account storm stations, stations for investigating the influence of the sea on the climate, the causes which result in local climates, and such questions as I have brought before the Commission to-day. In this opinion the Registrar General for Scotland concurs, he having considered, in the application to Government some years ago for funds to meet the expense of 17 new stations, that 72 stations were necessary for the purposes of his office.

14,376. (*Mr. Samuelson.*) Are you aware what number of stations are under the Registrar General of England?—I understand there are 47.

14,377. Is there any reason why the number of stations relatively to the area should be greater in Scotland than in England?—Yes. The physical conditions and climate of Scotland are much more varied, and its geographical position with respect to atmospheric pressure, temperature, winds, ocean currents, and other points affecting the meteorology of north-western Europe, is so important, that supposing England represented by 60 stations, Scotland with its adjoining islands would require at least 100 stations to be as well represented. Besides, different parts of England are still in many points very imperfectly represented. Wales, for instance, which is so very important in connexion with the meteorology of the British Isles, has only one station on the whole of its west slope. Then, excepting the station at Gloucester, the whole valley of the Severn is unrepresented.

14,378. Is it the case in Scotland that the stations have been established upon any scientific system?—We have endeavoured to establish our stations on a scientific system, and this has been done so far as our circumstances rendered it possible.

14,379. The possibility of finding observers, for instance?—Yes, the possibility of finding observers in suitable localities; we have, however, repeatedly refused applications because it was considered the stations already in the district were sufficient. One point that we have given a great deal of attention to is local climate; for the purpose of investigating which, we have been induced to establish perhaps more special stations than otherwise we should have done. It is known, for instance, that the country to the west of the Spey has a vegetation totally distinct from that on the east side of the river, showing two climates very different from each other in many respects, a difference which is impressed upon the whole vegetation and agricultural produce of the two districts. It would be an extremely important problem to determine by statistics the meteorological differences between the two districts.

14,380. To know how much is due to the climate?—Yes. The temperature of the north-west part of Aberdeenshire is certainly different in several respects from that of any other part of Scotland, and the growth of trees is also markedly different.

The witness withdrew.

Adjourned to Tuesday next at 12 o'clock.

No. 6, Old Palace Yard, Westminster, Tuesday, 5th May 1874.

PRESENT:

HIS GRACE THE DUKE OF DEVONSHIRE, K.G., IN THE CHAIR.

The Most Honble. the Marquess of LANSDOWNE.
BERNHARD SAMUELSON, Esq., M.P.
WILLIAM SHARPEY, Esq., M.D., F.R.S.
THOMAS HENRY HUXLEY, Esq., LL.D., Sec. R.S.
HENRY JOHN STEPHEN SMITH, Esq., M.A., LL.D., F.R.S.

ROBERT H. SCOTT, Esq., M.A., F.R.S., further examined.

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

14,381. (*Chairman.*) Have you a large stock of instruments at the Meteorological Office?—Yes, a very considerable stock; the amount is given in each of the annual reports. We have a large stock for the Navy, and a considerable number for the Mercantile Marine. We have to keep a sufficient stock to keep the Navy continually supplied, and the actual value of this may be some 3,000*l.* or 4,000*l.*, speaking generally.

14,382. Are a considerable number of new instruments required every year?—A considerable number are damaged on service, and we do all that we possibly can to repair instruments, and do not purchase entirely new ones if we can make the old ones do, *i.e.*, if they can be repaired satisfactorily.

14,383. Are your instruments employed for any other purposes besides those which you have already referred to?—They are solely used in the service of the Office. We do not lend to private persons except in one or two cases, so that they are entirely used in the service of the Office.

14,384. Is a proper history kept of each instrument?—There is a history of the varying service which each instrument has been engaged on, and the number of times that it has been verified. Those particulars are all kept in books, so that we can trace all the instruments which have ever been in the Office.

14,385. Do you refer to each particular instrument?—Yes, each individual instrument. If I may illustrate the importance of this by saying that recently we have had the greatest possible difficulty in tracing the instruments which Sir James Ross used in his Antarctic Voyage, because at that time there was no history of the instruments. Things have been kept since 1864 precisely as I have said. Each individual instrument is known by its distinguishing number.

14,386. What improvements have been introduced into the instruments from time to time?—We have found that the instrument makers can make their instruments with much more accuracy, and they make better instruments than they did before the Office commenced to work, and this has tended to the gradual introduction of a better class of instruments for general use. The first thing which the Office did under Admiral FitzRoy was to request the Kew Committee of the British Association to devise barometers, thermometers, and hydrometers for use on

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

shipboard; the barometer has since been introduced in certain Foreign Navies, and it is called the Kew marine barometer. Then there have been also special barometers made, at Admiral FitzRoy's suggestion, for use on board ships of war, because the firing of heavy guns will break ordinary barometers, and these "gun barometers" are specially fitted for use on board men of war. In all instruments every improvement which seems likely to be of value has been, at all events, tried, and if it is found satisfactory has been adopted.

14,387. Have many of those improvements of which you speak been recommended by the members of the Meteorological Committee?—Not particularly by the members of the Meteorological Committee, but some of them have been suggested by the instrument makers, and there have been suggestions from various sources. I cannot at present think of anything which has been actually suggested as an improvement since I have been connected with the Office, except the addition of a fuller vernier to the gun barometer, and the alteration of rain gauges so as to serve for collecting and recording snow, but most certainly there were improvements introduced by the Meteorological Department under Admiral FitzRoy in the matter of barometers, aneroids, porcelain in lieu of metal for thermometer scales, deep-sea thermometers and maximum and minimum thermometers for use in H.M.'s ships (in the chronometer rooms).

14,388. What measures are adopted as to the verifications of the instruments?—All the instruments are verified at Kew before they are received for service, and on return from service they are not reverified at Kew, unless they have been in the hands of an instrument maker. If they have passed out of the hands of the Office into those of the instrument makers, and any alteration has been made in them, they are sent back to Kew, but if they are simply returned from the ship to us we compare them with our standards, and if they agree as well as before they went to sea they are not sent to Kew again.

14,389. Do you know whether similar care is exercised in other establishments of the same nature abroad?—I should say decidedly not. They are now commencing to use the same care, as they are applying to England for the same modes of testing the instruments. All maritime barometers, for instance, must be tested in the vacuometer to find the range of pressure, and the only vacuometers in existence, as far as I know, have been those made in England. There is one at present going out for this work to Berlin, for the Prussian Navy. But the difference between this office and all other offices with which I am acquainted is, that all the instruments from which the observations are obtained which we use in our discussions belong to the office, and we do not use observations made by private instruments, unless we have got the verifications of those instruments, and that case has not yet arisen to any great extent. Perhaps I might be allowed to amend one answer which I gave before, as to the Members of the Committee introducing alterations. Professor Miller made a suggestion about the improvement of the deep-sea thermometers; it was a re-invention of something which had been done before, but at all events it was original on his part, and that was done in the year 1869.

14,390. What has been the origin of the self-recording instruments in use at the observatories?—On a former occasion I spoke of a general conference held at the British Association meeting in 1845, and the great question there was whether or not people could agree on uniform hours of observation. As they could not do that the English representatives there, namely, Sir Edward Sabine, Sir John Herschel, and other English gentlemen who were there, determined that they would introduce a set of instruments which should be independent of the hours of observation, so that you could get continuous records; and ever since that year, 1845, the continuous records at Kew and Greenwich have been gradually perfected and brought to their present state. The chief persons who had to do with the invention of these instruments were Mr. Charles Brooke, F.R.S., and Sir Francis Ronalds, who has recently died. Several improvements have been due to Mr. Beckley the mechanician at Kew, &c.

14,391. Are the self-recording instruments found to be perfectly satisfactory at present?—Not perfectly satisfactory, for several reasons. One reason is, that the time scale is not sufficiently long. If you look at the photographic record for one day given in the First Annual Report you will see that if it could be extended over a much longer space, so as to afford, say two inches for each hour, it would be much more minute. We do not get records of sudden squalls, or any of those sort of things. The time scale only allowing 0·35 in. for each hour, it is found that anything very transient might pass without being recorded, and a lengthened time scale might be more advantageous. There are various difficulties which have only been discovered since we have had so much practice, various defects of photography, and defects as to the shrinkage of paper, &c., whilst there is also a difficulty in this process that it is only suitable for application in a well populated country, because of the difficulty of keeping up photography, &c. But these instruments seem to be, on the whole, more satisfactory than any other self-recording intruments which are at present in existence.

14,392. Are you from time to time still introducing improvements?—Yes, we are decidedly introducing gradual improvements in the management of those instruments.

14,393. Does their use entail any special precautions which may in some measure affect the observations?—In certain cases decidedly. For instance, for the thermometer it is absolutely necessary that an instrument which costs about 100*l.* should be well protected, and should be in a stable building; but the fact of having it in a building which would be safe against thieves, and against damage of various kinds, would naturally affect the perfect accuracy of the temperature, and we do not find that those thermometers give the absolute extremes of temperature; they do not give such great cold or such great heat as instruments more fairly exposed would do; but, on the whole, they act exceedingly well. A criticism has been frequently made against us that we have not built special buildings, and because we have adapted our thermometers to the floors of the different houses. At Aberdeen we could not get a floor which would do for placing the thermograph at a less distance from the ground than forty feet. We should not wish it to be more than twelve feet in any case, but as it is we cannot afford to build buildings for the thermometers, and we have to take the existing buildings and do the best we can. Similar cases have arisen in three or four instances, but especially at Falmouth and Aberdeen.

14,394. You have not erected buildings yourselves, have you, in any instance?—At Falmouth we have not erected the building, but the building that is supplied to us was erected for us. We have not erected any other buildings. At Valencia we have fitted a dwelling-house as an observatory, and at Aberdeen the Board of Works have allowed us to use a part of the buildings of King's College.

14,395. If you had to provide buildings, that would in all respects meet your wishes, would it entail considerable cost?—It would entail a considerable additional cost.

14,396. Can you mention the sort of sum that it would require to provide a building in every way fitted for the purpose?—I am not prepared to give an estimate; it is so very dependent upon the place where you have to build it, and the materials which you can build with; and the idea of building special observatories was far beyond anything that was ever contemplated. The original endeavour was to attach our observatories to existing establishments, astro-

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

nomical observatories of some sort or other, and that in most cases we have succeeded in doing.

14,397. What have you at Aberdeen?—At Aberdeen we have got an existing establishment, but not an existing observatory. There is no regular astronomical observatory there; there is simply a telescope for teaching astronomy.

14,398. Do you pay rent for the use of buildings?—We do not pay rent excepting at Valencia, where the Committee have taken a house. We had to take a house and garden there; but in all other places we use existing buildings. At Falmouth the Royal Cornwall Polytechnic Society pays a special rent for the building which we have as an observatory. In all the other cases there is no rent paid.

14,399. With respect to the ocean, do you issue regular instructions for the observations?—Yes. We have slightly altered the instructions which Admiral FitzRoy issued, but we issue regular directions to observers for taking all observations.

14,400. What was the result of the Brussels Conference with respect to ocean observations?—That an abstract log for recording observations was devised by the representatives of the different nations which were represented at Brussels, and they all agreed to take observations in accordance with that log, and to issue an uniform scheme of instructions. The idea at that time was, speaking generally, that the observations were to be sent to Lieutenant Maury to America to be discussed.

14,401. Has the plan which was then adopted been generally acted upon since?—I should not like to say that it has absolutely not been acted upon, but it has hardly been acted upon at all. In fact I am at present issuing, or rather shall issue to-morrow, a circular to all the governments that were represented at Brussels, to inquire the extent to which they have acted on the resolutions of this Brussels Conference. Practically speaking, this country has been the only country that has worked really on the plan. The Dutch very soon set themselves free from the literal rules laid down at Brussels. They have worked exceedingly well at maritime meteorology since, but not exactly on the plan of the Brussels Conference. This country has adhered more closely to the Brussels Conference; as for other nations, there has been hardly any work at all done. For the United States, the operations of the Naval Observatory, which had been almost exclusively meteorological between 1851 and 1861, were re-directed to astronomy on the outbreak of the war, so that little meteorological work has been done there since. Practically the Brussels Conference led to the foundation of the Meteorological Department of the Board of Trade, and was the first attempt to establish an uniform plan of operations at sea.*

14,402. Is there at present an idea of holding a new Maritime Conference?—A sub-committee, consisting of five gentlemen, of whom I am one, has been appointed to organize such a conference, and it is intended to hold such a private conference this autumn either in London or at Utrecht, in order to see in what position we are, and whether there are sufficient grounds for summoning an official conference.*

14,403. Have you any expectation of co-operation from other countries?—Yes, of very extensive co-operation.

14,404. By whom has this committee been appointed?—By the Permanent Committee of the Vienna Congress. The gentlemen who form that committee are Professor Buys-Ballot of Holland, Professor Mohn of Norway, Captain Mouchez of France, M. Neumayer of Berlin, and myself.

14,405. How are the marine observations dealt with?—When a log comes in it is first examined very carefully, and the Marine Superintendent, Captain Toynbee, carries on a correspondence with the gentleman who kept the log, asking various questions so as to render it as complete as possible. It is then handed over for discussion, and the observations which require correction, such as the barometer for temperature, and for elevation above the sea level, are corrected for such portions of the sea as are likely to be required for any special investigation. We do not take the log and at once correct everything throughout. We simply correct the portion which we are likely to use immediately. These observations are conveyed to us in a certain form, and they are used according as they may be wanted for the investigation.

14,406. A plan was proposed by the Committee of Inquiry in 1866; has that plan been followed?—No, it was found not practicable. The plan which they proposed was that all the observations for any definite day, or any definite set of observations for definite hours, should be put upon a separate card, with the idea that those cards could then be sifted and handled so that any cards bearing upon the same subject could be thrown together. But we have found that it was better, instead of using these loose cards which we tried, to have simply a large book, with certain columns agreeing with the log. In this book, each opening corresponds to one month and to a definite small portion of the sea, one single-square degree. We find that by having the books bound they are more manageable than loose cards, and are less likely to get astray.

14,407. How is the discussion conducted?—A definite area of the sea is taken, and all the data books for it are consulted. Those books are called data books into which the extracts are made. They are then dealt with and treated in order to see what we can find out from them, and if there is a sufficiency of material they are further investigated to the most minute particulars, such as the daily march of the meteorological elements, the barometer and thermometer for that region, if there is a sufficiency of material to justify such discussions. The whole of the material in the office for that area is discussed at one time. It is not one single element that is discussed, neglecting all the rest. The material, as far as we can say so, is exhausted for that district.

14,408. Is there a difficulty in preparing accurate charts of large areas?—It is excessively difficult. To give the Commission an idea of this I might hand in a certain chart which is to be found in the Report for 1872, page 7, and you will observe the numbered squares therein: at present we have extracted the whole of the observations for those squares. For the whole area of those numbered squares there are 125,000 observations, and for the little shaded square in the centre there are 75,000 observations. If, therefore, the results for the whole area were shown on a single chart, this portion would give its weight to the whole of the results. This chart, which I have brought, will show the Commission more strikingly even than that how very limited the distribution of observations is. This is a chart (*producing the same*) which shows for a single month (February) all the observations taken in three years for the sea temperature, near the Cape of Good Hope. It shows that all the observations run in a certain stream, and in certain portions there are no observations whatever, and, therefore, if you attempt to give the mean all over the whole of this area, you entirely ignore those places where there are none at all. There is this serious difficulty in any dealing with observations, that the observations run along the tracks of ships, and you cannot get observations elsewhere.

14,409. Over how long a period do those 75,000 observations that you have just spoken of extend?—Since about the year 1856. I cannot say precisely when they first began, because there are some old logs which have been received from private sources, which date from former times. These have come in and have been used for some observations, but not for all. They have been used for wind observations, but not for the barometer. So that it is not quite easy to say exactly, but the observations began to come in about the year 1856.

14,410. For large areas do you consider that those charts that you have been able to prepare are prac-

---

[* See Supplementary Evidence in Appendix III., p. 6.]

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

tically useful?—We have hardly prepared any charts for large areas; such charts are hardly useful for sailors, because anybody who really wants a chart makes a very minute inspection. We are at present publishing monthly charts for that single-square area to which I have referred above, entirely neglecting the remainder, which we are working up subsequently. But the difficulty of publishing charts for a large area is that you necessarily neglect a great number of minor peculiarities which may make all the difference to a captain about his making his voyage or not. The large Pilot Charts of the Admiralty are for three months at a time, and for a very much larger area than one ten degrees square; but for practical sailing these can hardly be used.

14,411. To what extent are the results obtained abroad utilized by the office?—Whenever we find good charts which are capable of being reproduced at comparatively small expense we reproduce them, as, for instance, the Dutch charts of the temperature of the South Atlantic and of a portion of the North Atlantic have been reproduced, not combined with our information, but reproduced alongside of our information. A paper on the form of cyclones by Mr. Meldrum of Mauritius; a paper on the winds of the North Atlantic by Herr von Freeden of Hamburg; and a Dutch paper on the passage by the Suez Canal to the Straits of Sunda, have all been reproduced as the most important papers on maritime meteorology, which have been published of late years. They are issued for English sailors and published as translations, the Committee assuming no responsibility about them excepting that they are translations.

14,412. Do you think that there is a reasonable hope of carrying out the ideas of the Committee of Inquiry as to completing the subject of ocean meteorology in 15 years?—It is perfectly impossible. We have been now seven years at work, and in that time we have thoroughly examined all the materials in the office, and have produced various results as I shall explain subsequently, but as to the special mode of inquiry proposed by the Commission in their Report we have matter prepared for the entire district shown in the chart in our Report for 1870, before referred to, but are as yet only actually publishing monthly charts for this one small square, but of course this is an exceptionally troublesome square from the mass of information in it. But the idea of the Committee of Inquiry was that large charts giving the results in a very general way should be published, whilst the Meteorological Committee have looked more for minuteness in the results which they have sought to attain.

14,413. Do you propose to deal any further with that particular square?—Not with that particular square. The whole of it will be published next month. Now we are dealing with certain squares round it; we have dealt with that square in the first instance for every single degree, and for every month. That was thought to be too cumbrous, and so we are publishing monthly charts for every two-degrees square, giving 25 sub-squares for the district, that is 10 degrees each way. The squares all round will not by any possibility bear such minute treatment as that, because there is not material enough for it. There are only one or two portions of the sea, the entrance to the Channel perhaps, and the point of the Cape of Good Hope, where we could get material enough for such a minute discussion as we have carried out. Almost every ship, that goes south of the Equator, passes through that square. She must do so, both going and returning. It is the crossing point for every track, and it is a place where there are calms and variable winds, so that the duration of the voyage in a great measure depends on the winds that are met there.

14,414. Do you consider it better to publish separate charts for each element, or to enter the whole information for a given district on one chart?—Captain Toynbee and I are of opinion (and the Committee have confirmed our decision) that it is better to publish all the information for one district at once, because the number of charts would be so enormously multiplied if the other plan were followed, and the turning over from one chart to another would be exceedingly troublesome. We find that the different subjects illustrate each other, as for instance, the way in which the surface currents are caused by the winds, all such points as these come out if you show the wind and the current on the same chart. But there is a great difference of opinion between ourselves and the Dutch, the two offices who publish the most charts at present. The Dutch publish one subject on each chart, whereas we publish the different subjects on the same chart. Our opinion is in favour of our own method, but it is a question which is not by any means decided.

14,415. Has the Dutch system any advantages in certain respects?—It is more simple undoubtedly; but I find fault with the Dutch system for the same reason that I have already mentioned to the Commission, as an objection to general charts of large area, that they will give the mean temperatures for the parallels of latitude when all the meridians of longitude are not represented in the observations.

14,416. What charts were issued by the Office when it was under Admiral FitzRoy?—He first commenced to reproduce Maury's charts in a form for English sailors. He issued a set of wind charts which were simply conversions of Maury's Pilot Charts, but gave the data graphically instead of numerically. Maury's Pilot Charts differed from his wind and current charts, as the observations in the latter had been published in the way that I have shown in the chart I have just exhibited to the Commission, by giving each of the actual observations and putting it down where it was taken. In the Pilot Charts, Maury, and Admiral FitzRoy after him, in the Board of Trade Wind Charts, threw all those observations into the middle of the square. In addition to these, Admiral FitzRoy published some special wind charts for the Black Sea immediately after the Crimean war, and commenced publishing special monthly wind charts combining his own observations with Maury's for the North Atlantic and giving also currents, temperature, magnetic variation, &c., but he only published four in the year, one in each quarter. The great difference between those wind charts and any other wind charts that have hitherto been published, excepting what we are publishing now, was this, that Admiral FitzRoy began to refer to the mean force of the wind, whilst Maury only gave the direction of the wind. There are no such things as wind charts in existence excepting those few of Admiral FitzRoy's which show the force of the wind; they usually simply give the direction.

14,417. What charts have been issued under the Meteorological Committee?—The first were the monthly charts of the surface temperature of the South Atlantic; then there were monthly charts of the meteorology of the sea near Cape Horn. There were monthly charts of the currents and surface temperature of the North Atlantic for each month for 2° half-squares, with a general current chart. The whole of those were discussed from materials collected by Admiral FitzRoy, and whenever possible we published together with our own data the most important of the Dutch results, and for the currents Maury's and Rennell's materials, so as to give everything. Daily charts of the weather in the North Atlantic for certain days in February 1870, and the time the S.S. "City of Boston" was lost were also published. The last publication has been a discussion of the work done during Sir James Ross's Antarctic Expedition, which was investigated partly with reference to the transit of Venus, and which has just appeared; and the publication is now in progress of those charts of which I have been just speaking, of this square in the middle of the Atlantic.

14,418. Have you any additions to make to what you have already stated about the 10-degrees square?—Not very much; merely that we have gone to much more minuteness than 10 degrees. The idea which was apparently originally contemplated by the Commission of Inquiry was that the mean for 10 degrees

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

squares was sufficient; but we consider that there should be at least 100 means instead of one for that same district, if there be observations enough, in order to investigate the subject properly.

14,419. Have you anything to state about "Fragmentary Papers"?—Yes; this is a very important question, because the Commission of Inquiry stated their opinion at page 17, "That no original observations, no fragmentary papers on meteorology, be henceforth issued;" but it has been found necessary to work at fragmentary papers, as, for instance, at this discussion of the meteorology of the Antarctic Ocean, which is decidedly fragmentary. Moreover, we have had a special application from the Astronomer Royal to investigate the meteorology of Kerguelen Island for the month of December, so as to be ready to furnish the information to the expedition which is just sailing next month. We have also found that for certain districts there was more material than for other districts, and that it would be worth while to publish such results as we could for a district of which we knew anything, rather than wait, perhaps for a great many years, before we were able to publish results for a larger area. I may say, particularly, that besides Kerguelen Island we have published a discussion for one very small district of Vancouver Island. During the hydrographic survey of Vancouver Island a large mass of materials was collected for that district. There is practically nothing from the sea all round it, but we had some information for four or five years for that particular district, and we all thought that it was advisable to publish such results rather than to keep them locked up in the office. Some of them have been published in papers submitted to scientific societies; not all published by the office, but still the publication is admitted to be by the authority of the Office.

14,420. Did the Committee of Inquiry distinctly report that the publication of such papers was inadvisable?—They used the words which I have quoted. Admiral FitzRoy commenced by publishing fragmentary meteorological notices, and he published a paper on the meteorology of New Zealand, and observations made in various other places, in his first number, with very little attempt at discussion. We ourselves considered that a paper about Vancouver Island would be decidedly fragmentary, and therefore would be contravening the recommendation of the Committee.

14,421. Do they give any reason for their opinion with respect to fragmentary papers?—No.

14,422. They do not state that they consider that it would dissipate the attention of the Committee from more important work?—It was not a recommendation actually to the Committee, it was a recommendation to the Department. The Committee was not in existence at the time the Commission sat, but the Committee have considered that this report of the Commission might certainly be dealt with in a liberal spirit.

14,423. With respect to land work, will you describe the method of observation at the observatories?—The method is, that continuous records are taken photographically, and mechanically in the case of wind, by means of instruments at these observatories. The reading for every hour is measured at the observatory, and the curves and measurements are sent up to the central observatory to be examined, so that the observatories are simply responsible for keeping their instruments going, and for furnishing copies of the hourly readings obtained therefrom, with a simple daily journal of the weather, &c.

14,424. What are the functions of the central Observatory?—In the first place they commenced by the testing of all the instruments sent down to the observatories, and the teaching of the observers; but now its duties are to receive all the records weekly, to examine them and send them up monthly to the office in London. The whole question of the accuracy of the outlying observatories in keeping up their work and measuring their records is left by the Office to be settled between Kew and the observatories, the Office simply dealing with the subsequent discussion. If we have any question to ask about the observations, we in the first instance ask the Kew Observatory about it.

14,425. Is that the principal function of the central Observatory?—As soon as we receive a set of records which are presumed to be correct, and they have been tested and posted to us with the signature of Kew, then we proceed to deal with them. Kew is in fact simply responsible for the control of those seven observatories including itself.

14,426. Are there any other functions of the central Observatory to which you wish to call the attention of the Commission?—Nothing beyond what I have already mentioned on a former occasion as to our work of a general kind.

14,427. How are the curves reproduced for publication?—A member of the Committee, Mr. Francis Galton, has invented a certain pantagraph, by means of which the automatic record is compressed to one third of its length, leaving its height the same. This instrument has been specially invented by Mr. Galton for us. It was then further reduced by an ordinary pantagraph, made by Wagner of Berlin, and engraved on copper. The whole of the records for one day are engraved on a zinc plate by Mr. Galton's pantagraph. They are reduced one third in their length, and on page 54 of the Report of 1867 you will see a specimen of the final result which we produce. The zinc plate at its true size is represented at pages 26 and 27 of the Report for 1870. It contains the record of one day for one observatory, while the final result for all the seven observatories for five days for all the elements is shown at page 54, as I have just said.

14,428. Do you know any other mode of obtaining mean results from your photographic curves besides the numerical calculation of hourly measurements?—There is the use of this instrument, with which I do not know whether the Commission are acquainted or not—Amsler's planimeter. We have recently found that by measuring the area of a curve by means of this instrument, and then determining what the mean ordinate of that curve would be, which can be done very speedily, we can get the result for a day in about ten minutes. If we could take the means from our published plates, the economy of time would be enormous. I hope in a few days to lay a communication on this subject before the Royal Society. The amount of accuracy is exceedingly great, so that when you have got the photographic record, you can by measuring it get a result which does not differ in any case more than two or three tenths of a degree from the result obtained by taking the mean of 24 hourly observations. This instrument is very extensively used by engineers for taking out areas and taking out quantities. Mr. Francis Galton suggested that we should use it, and we have commenced to use it; it has not been authorised and we have not begun to publish such results, but preliminary investigations show that they agree nearly exactly with those obtained in the usual way; if such measurements were admissible we should hardly measure any of our tabulations at all, or give any hourly readings at all; we should only give the mean results. We should simply take the photographs and measure them off at once, but hourly readings are wanted for other purposes. It would be a prodigious saving of time if these instruments could be introduced.

14,429. (*Professor Smith.*) You would measure the area for every 24 hours?—Yes. (*The witness described the use of the planimeter.*)

14,430. Is it strictly correct, or is it an approximation?—It is as correct as it possibly can be. The person who is the best authority on the subject is Mr. F. J. Bramwell, C.E., F.R.S. The instrument can hardly be made quick enough to supply the demand for it, it is so accurate. It is the first time that it has been tried in this country on anything of this kind, but engineers use it very much. I have here the actual figures which show the amount of accuracy

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

which we have obtained on the first trial, and which I intend to submit to the Royal Society.

14,431. (*Chairman.*) What numerical discussions are carried out in the office?—The numerical discussions are to obtain five-day and monthly means for pressure and temperature (dry and wet bulb). Means for the wind are not yet published, as that must be discussed in a different way. We have also daily means for the elements mentioned, but those are not published. We have not been able to carry out all the original proposals made by Sir Edward Sabine in his various notes laid before the Royal Society in the 15th volume of the Proceedings, to which I have referred before. But such discussions as we are carrying out have been distinctly proposed by Sir Edward Sabine, and they have been literally carried out. They do not include at present the hourly value for each month. That will be a subsequent discussion. What I mean is that we shall calculate the mean for to-day, but we are not now calculating the 31 means at 1 o'clock for the month of May, so as to show the hourly mean for each month. That will be subsequently discussed when we arrive at the end of a certain lustrum of five years, about which I spoke on the last day.

14,432. Has any wish been expressed for the issue of more minute particulars of the curves than their mere reproduction?—We have received recently a memorial signed by about 30 gentlemen, asking that the actual hourly tabulations should be placed at their disposal. Several gentlemen have asked for such things before, but it came forward signed by several well-known gentlemen, including Dr. Joule and several others, and simply asked that everything which is furnished to us by the observatories should be given to the public, or should be accessible to the public without calling on everybody to pay for the actual copying of such information as he required. The Commission must understand that our position at present is this, that anything which is in the office, no matter whether fully discussed or partially discussed, or not discussed at all, can be obtained by anybody who chooses to pay the price of copying it, but that stipulation is absolutely prohibitory to a great number of investigators.*

14,433. What readiness has been evinced by those who ask for such information to pay for it?—Very slight indeed. 32 men signed the memorial, and only five of them have agreed to pay a subscription which would bear no proportion to the extra expense in clerks' time which they are imposing on the Office.

14,434. What sort of amount would that be?—1*l.* a year.

14,435. Do you mean that all the information that they ask for could be supplied for 1*l.* a year?—We supply daily weather charts, the subscription for which is 1*l.* a year; we look to have some subscription which would cover the cost of postage, &c. of those hourly readings, simply in order that we should recover some portion of the cost. It will throw heavy work on our clerks and cost a good deal of money; but we have only received altogether 14 subscribers for those charts, and of those only five are gentlemen who signed the memorial.

14,436. Are you producing those tables at present?—We are preparing to produce them; the forms are not ready yet, but we shall produce them as soon as possible, and issue a very limited number.

14,437. What is the special value of the reproductions of the curves?—Those reproductions of which I have spoken are for tracing the history of the weather, and showing the way in which the various phenomena pass over the several observatories. The idea which was originally contemplated when we first started was, that each meteorologist could take one of those curves and could take any reading that he wanted by measuring it off, on the side scale given on the plate, but that entailed too much labour, so that now the plan is to furnish them in addition with the actual measurements which we have taken for every hour. These continuous records are perfectly invaluable for anyone tracing the progress of weather, but for physical discussions the measurements of the curves, that is the hourly values, are also required.

14,438. Is there a want of funds for a more complete treatment of the subject of land meteorology?—A very serious want of funds. As I mentioned before, for any serious discussion like that of the hourly values for all the elements for five years we are not provided with a sufficiency of funds; in fact the amount of our staff for land meteorology would be sufficient to discuss the results for one observatory, but not for seven. It is in that sort of way that the original provision of clerks who were to discuss the work was quite insufficient, the amount of materials being so enormous.

14,439. What you would consider a complete treatment would require a very much larger expenditure?—Very much larger expenditure.

14,440. Can you at all give the Commission any idea of what would be required according to your view?—I should say that a skilled scientific calculator, and a staff of four or five clerks, would certainly be wanted, and that the expense of that could not be less than 1,000*l.* or 1,500*l.* a year. Our actual expenditure on clerks is about 2,800*l.* a year for the whole staff, of which 800*l.* is for land meteorology; but we should want much more money in order to provide for a higher class of scientific work than is at present available for land meteorology, in order to discuss everything that every one might want to determine, or even the meteorological conditions for each of our observatories, with the same degree of minuteness, not actually as is done at Greenwich, because I think that perhaps too much may be done there, but certainly on the same sort of scale as at Greenwich. Practically there is hardly any experience of the amount of work that is required in order to have such discussions, because no institution except the Radcliffe has ever attempted in this country to discuss readings for every 24 hours, excepting in the one investigation which the Astronomer Royal is now carrying out, of the photographic records of temperature for 20 years. I might say that an estimate of about 1,200*l.* a year would be the least that would be required for everything that is demanded to be carried out by us.

14,441. Will you describe the general features of the system of weather telegraphy?—There are a number of reporting stations, 29 in these islands, directly under the orders of the office, and paid by the office, and in addition we receive information from 22 foreign stations by way of exchange with the different organizations in the several countries. Our stations are all supplied with instruments by the office, and are inspected regularly, as I have already explained, and then they furnish to us those observations. Then in addition to that we have got a number of stations, nearly 130 I believe, at which signals are exhibited. In this chart, which I may produce, the red stations are the stations which report to us, and the black stations are the stations where our warnings are put up, and the crosses on the chart are our observatories. The blue ones are stations which have a partially self-recording outfit, and the red stations all over Europe are stations from which we get reports every morning.

14,442. Are the foreign stations supplied with your instruments?—No, they are supplied by their separate governments. A list of those stations is on this chart (*handing in the same*).

14,443. Does your system differ from those existing in other countries?—Very seriously. The observers are very much more under the control of the office than they are abroad. They are directly paid by us, and we are able to remove them from their meteorological duty of reporting, whereas in other countries it is the employés of the telegraphic stations who furnish the reports, that is to say the telegraphic observers.

14,444. Do you know what proportion the cost of your system bears to that of the chief Signal Office at

---

* [See Supplementary Evidence in Appendix III., p. 6.]

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

Washington?—According to our last Annual Report the cost of our telegraphy, including the salaries of most of the clerks employed in it, was 2,762*l.*, whilst by the last Annual Report of the American Signal Office, the estimate of expenses, exclusive of salaries, is 50,000*l.* The salaries are all charged to the military vote. It should, of course, be remembered that we are dealing with very different areas. The whole system in the United States is on a totally different scale. There the telegraph is stopped for a certain portion of the time each day for the transmission of those reports, and all the post offices disseminate the information. In fact there is no comparison between the modes of carrying on the work.

14,445. Do you know whether the results obtained by the Signal Office at Washington are of very great value?—They certainly are of exceedingly high value. With such an organization as they have they can, of course, carry on much more elaborate discussions than is possible with us. General Myer has three gentlemen, one of them Professor Cleveland Abbe, formerly the head of the Cincinnati Observatory, who are his assistants, and in addition he has the chiefs of the various secondary stations through the country, so that altogether he has a great deal more scientific power available for discussion than is elsewhere the case, but that the results he obtains are exceedingly good there is no doubt.

14,446. Do you mean, strictly speaking, that all salaries are excluded, or only the salaries of the heads?—All salaries. I will read the actual words:—"For "manufacture, purchase, or repair of meteorological "and other necessary instruments, for telegraphing "reports, for expenses of storm signals announcing "probable approach and force of storms through- "out the United States, for the benefit of commerce "and agriculture, for instrument shelters, for hire, "furniture and expenses of offices maintained for pub- "lic use in cities, or post-receiving reports, for maps "and bulletins to be displayed in chambers of com- "merce and boards of trade rooms, for books and "stationery, and for incidental expenses not other- "wise provided for, 250,000 dollars." There is no provision whatever for a single salary. In fact there is no balance sheet.

14,447. You know nothing about the details of how the money is spent?—They furnish no information as to that, but I believe that the whole thing is a military organization, and the pay is all on the vote for the army.

14,448. What relations exist with foreign countries as to the exchange of information?—We receive observations from all foreign countries with which we care to be in communication; for instance, France, Holland, Norway, Sweden, Denmark, and the town of Hamburg, a regular exchange, to a certain extent, of station for station. The Norwegians send us three reports, and we send three reports every day; the Danes send us two, and the Swedes send us four, and they only get the same reports as go to Norway, but it is a system of reasonable exchange. We have an exchange with two separate organizations in France, and the French furnish us with the Spanish reports. This all refers to a daily exchange, and in addition to that we send to each other special messages in case of storms, and that means that this office sends at least 20 warnings to foreign countries for one which it receives, because we lie, so to speak, in the Atlantic. We let each other know specially when there is anything of importance to remark beyond what is shown in the regular reports, by sending special telegrams to each other.

14,449. A correspondence between the Meteorological Office and the French Ministère de la Marine was presented to the House of Commons in 1868; does that correspondence indicate closer relations between that office and your own than exist elsewhere?—It indicates most remarkably the peculiar relations which exist, because the meteorological service of the Ministère de la Marine may be said to be managed in connexion with the Meteorological Office in London. The French naval authorities will have nothing to do with their own Observatoire. The correspondence shows that they furnish us information from stations which report directly to us, and that the warnings which are issued to the coasts of France are those which are sent to Paris from the London office, and they only extend to the coast of France from Dunkerque to Nantes. Only recently the Préfet of the Fourth Arrondissement at Rochefort asked for leave to warn the coast of the Bay of Biscay, and the Ministère de la Marine, instead of asking the Observatoire if they would sanction it, wrote to ask the Meteorological Committee if they would sanction it. The duty of warning the coasts of France through the Ministère de la Marine rests with the London office, but it has been repeatedly stated to France that the Committee are only too anxious to give up this duty the instant that the French think fit to undertake it themselves. In money matters the French Government is exceedingly liberal to us, and our relations are most cordial and friendly, both with the Observatoire and with the Ministère de la Marine.

14,450. A system of synchronous observations has recently been established; will you be so good as to explain the system to the Commission?—The chief Signal Officer of the United States, General Myer, came to the Congress of Vienna, and he proposed that at all our stations synchronous observations should be taken at a definite epoch of Greenwich time, or a definite epoch of Washington time, but that each country should observe at the hour which is given by its own longitude, so that we should have absolutely simultaneous observations. For instance, the daily weather reports and observations which we deal with are taken in London at 8 o'clock, whilst they are taken at 7 o'clock, or even before that, at Stockholm. We cannot get actually observations at the same moment. Different nations, particularly the United States, ourselves, and the Russians, have agreed to undertake to furnish observations at a definite epoch of time, and those observations are all copied. I keep copies of our own, and we send copies to the United States at Washington, where they are being discussed, but this has only commenced since the beginning of this year.

14,451. You are not at present able to say how far it is likely to succeed?—It seems exceedingly likely to succeed here. We have a number of gentlemen volunteering to join; we had something like 60 men to commence with, but I do not expect that anything like that number will continue, because it involves being at home every day at a definite hour, a quarter to 1 o'clock.

14,452. Does that mean Greenwich time?—Yes, for these islands, but it is about 7 o'clock Washington time; the night hours come in the middle of the Pacific.

14,453. Are there any observers who have undertaken to observe on the ocean?—Not officially on the ocean; but there are observing stations started in the Sandwich Islands, and there are instruments at Tahiti that we might possibly get observations from, but the Chinese observations and those from Kamschatka would be taken at night.

14,454. Have any attempts of a similar nature been made previously?—The first attempt was made by Admiral FitzRoy in his very first report, for 1857. The first thing that Admiral FitzRoy stated was his wish that such observations should be collected to be used in charting the weather. Then, in the year 1861, M. Le Verrier commenced an organization for a certain amount of work, and M. Le Verrier's proposal was that France should take the Atlantic Ocean, while England should take the Indian Ocean and Russia and America should take Asia and the Pacific and America. This was hardly fair, so to speak, because the only place from which satisfactory results could be published was the Atlantic, and the French could furnish no quota of observations from the Indian Ocean or from the Pacific, whilst they would receive everything from other places. They commenced, and published for a year and nine months, for a part of

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

the year 1864 and for the year 1865, a book of daily charts called the "Atlas des Mouvements Généraux de l'Atmosphère," but that has been suspended; it was suspended as soon as M. Le Verrier left the Observatory. Since he has returned to the observatory they have talked about recommencing this work, but have not done anything. Then in addition to that, by carrying out to a great extent Le Verrier's idea, there are these daily charts for the Indian Ocean, of which I submit one, which have been commenced by Mr. Meldrum of the Meteorological Society of the Mauritius, which are at present in process of publication. These are produced by taking ships' logs and interpolating the observations for the hours that you require. Such are the attempts which have been made hitherto. With regard to the French, I may say that M. Le Verrier proposed a set of gold medals to be given to captains who gave the best observations, but the Meteorological Committee declined to receive any medals, because of the jealousy that might be excited. Medals were given at first, but since the Committee came into operation, although we have furnished information, we have refused to receive any medals.

14,455. Do you think that the system which is just established is more likely to be successful?—It certainly is received with a great deal more readiness than the other; it deals only in a secondary way with observations at sea.

14,456. Has support been promised to it from several different nations as well as individual observers?—It has been, in the first place, from those nations which I have named. I think almost all the civilised nations have agreed to it. All nations of any consequence were represented at Vienna excepting France, and France has given in its adhesion. Everybody has, to the extent of their power, joined, but it is not until a matter has been worked for two or three years that you see whether it has really got vitality in it.

14,457. Daily charts of weather are published by your Office, have you any remarks to make upon this subject?—The only remarks that I have to make are as regards the way in which we distribute them, and the pecuniary arrangements about the daily weather reports. We issue altogether about 530 reports every day, and of these a considerable number are supplied free to small fishing stations, at which they are exhibited for the use of the public, and a certain number of others are supplied to the chief public offices, and some are supplied free to people who give us observations, while we receive in subscriptions, at the rate of 1*l.* a year, 355*l.*, (the sum received last year); but the price at which we issue the charts, barely leaves any margin over the cost of wrappers and postage. We have an issue of upwards of 530 copies every day, and the amount that we have received is about 350*l.*, and that 350*l.*, as I say, pretty nearly covers the whole of the expense of wrappers and postage. I may also say in connexion with this that we are endeavouring to produce charts which can be published in the daily newspapers, and the process seems to be very promising.

14,458. What was the Report of the Committee of Inquiry on Admiral FitzRoy's system of warnings?—That the results were not sufficiently satisfactory. The per-centage of failures was so large that they recommended that the forecasts, by which he used to foretell the weather for three days in advance, should be entirely discontinued. The report was so far unfavourable to the practice of warnings as carried out under Admiral FitzRoy, that the Treasury, in its letter of the 30th November, recommended their discontinuance. The Royal Society first proposed not to take up the warnings, but simply to take the scientific part of the duty of the office; as they considered that the warnings were practical work, and that that was not to be taken up by them. The Treasury said, "It appears to my Lords that if the other branches of the Meteorological Department are to be transferred to the Royal Society, a very strong case ought to be made out for the utility of these warnings before they could consent to retaining, under the superintendence of the Board of Trade, or of establishing under some other government department, a separate staff for the mere purpose of continuing them, and they are not disposed, with the information at present before them, to sanction any expenditure on that account." It was simply, as the Royal Society stated, that the report of the Commission was not favourable to the warnings, so that they declined all responsibility connected with them; and when first appointing the Committee they said that they would appoint a Committee which should not undertake storm warnings.

14,459. Were the tests that were applied on that occasion convincing to your mind?—Not at all thoroughly so. This deals with rather a difficult matter. The idea which appears to have been in the minds of the Commission was that a storm announced would be felt at every place on the coast which was warned, no matter whether that place was sheltered or not. Say a place like Scarborough; they took the reports of their man at Scarborough to know whether the warning had been justified at all or not. In fact they considered,—I might almost say they considered,—that every case of non-occurrence of a storm on any portion of the coast was a failure, whereas we consider that any case of occurrence on any portion of the coast is a success. It is a question as to the men employed to check the warnings. We found that the way in which they tested the warnings by taking the reports of the Receivers of Wreck was not satisfactory, because when we took reports from the coastguard men afterwards, who have even better opportunities of judging of the weather than Receivers of Wreck, we found that they disagreed with each other. I speak in the former case about the opinion of the Commissioners because of course I was not in the office, and had nothing whatever to do with the subject. I have since been testing my own warnings, and it has struck me that the test applied by the Commission was hardly a satisfactory test.

14,460. How far was the system appreciated by the maritime public of this country and by foreign countries?—It was very much liked in this country. There were a number of memorials sent in in 1867, praying for a restitution of the warnings. As for the French, at the very time of the publication of this unfavourable report by the Commission, the French Ministère de la Marine commissioned an old naval officer, Captain De Rostaing, to test the warnings, and he reported that they were right in 89 per cent. of the cases. He gave too favourable a report on the opposite side, so that testing with about the same amount of materials two gentlemen arrived at totally different results. But as a stronger proof of the general approval of the system, a system similar to that of Admiral FitzRoy, was established in Portugal, in Italy, and also in New South Wales, very soon after, or almost simultaneously with the temporary discontinuance of the system in England.

14,461. What was the system first established under the Committee?—They were given to understand that the grant would not be continued unless they consented to add storm warnings to the duties which they had originally undertaken. They then said that they would telegraph the fact of the existence of a storm, but they would not announce what sort of a storm it would be; they would announce in a telegram as much as they knew about it, but they would not attempt to do anything like prophesying. They used truly to say that the telegraph is the only means of obtaining information of the gale, and they cannot themselves go further than what the telegraph conveyed. This system was established at the beginning of the year 1868.

14,462. What results were obtained under that system?—The results as we have tested them have been that in 1872 about 60 per cent. of the warnings have been followed by gales, and they have been in time for gales, and about 80 per cent. have been

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

followed by a change of wind which to a certain extent justified the warnings. In fact in three out of five cases the warnings of gales, and in four out of five the warnings of strong winds, have been right.

14,463. How far have the signals been tested?—They have been tested in the first instance by our continuous records of the wind at all places where we could get them, and by the telegraph reports which we get from our stations, with any other reports which we could get generally. We tried to test them by means of the coastguard, and by means of official reports, but we found that the coastguard, being in coves and sheltered places, did not know what wind was blowing at sea. Although wishing to report on it they were not in a position to do so, and as we found that one and another made records which disagreed with each other, and that in certain cases the records from lighthouses were more trustworthy, we have endeavoured to get any information we could from the coast by putting up anemometers in exposed situations and getting observations taken at coast stations.

14,464. Has that been done to a tolerably satisfactory extent. Are you satisfied with it?—We are to a certain extent satisfied with it.

14,465. Have any modifications been subsequently introduced into your system?—Recently we have almost re-introduced Admiral FitzRoy's system. We now issue announcements of the direction and the force of the wind. We use Admiral FitzRoy's signals, the drum and cone, and the only difference between our system and his is that he sometimes used to hoist a drum which said "dangerous winds from nearly opposite quarters," and did not say which wind would come first, whereas we always say which wind will come first. We never hoist the drum alone, we always give an indication of the direction first. That system has been introduced since the middle of March last, two months ago. We have obtained certain results from our experience of six years, and then we have announced our readiness to make the change.

14,466. This change, of course, was made with the consent and approval of the Meteorological Committee?—Yes, everything is done by the Meteorological Committee. In fact, as I have mentioned, everything is referred to the Committee, and the whole action is to be found on their minutes.

14,467. What action has been taken as to the publication of forecasts?—The Committee are anxious that we should announce forecasts, that is, that we should announce in the afternoon paper what weather there is going to be to-morrow. That is what Admiral FitzRoy used to do, and he used to do it for three days in advance. Ever since the beginning of December last we have been regularly issuing those forecasts to the Committee, but never issuing them to the public. In fact the actual clerk who does that work is no more desirous of publicity than I am in the matter, and we are trying whether or not we can get sufficiently good results.

14,468. Is there anything in the position of the United Kingdom which renders it peculiarly difficult to form an opinion as to coming weather for our own coasts?—Most decidedly. The fact is that we are entirely exposed to the westward. We have no stations outside us to the westward, and while I can give intelligence from our system of every storm, or at least almost every storm, that goes to Denmark, or to the coast of Germany, I can do very little for our own west coasts, because we have to wait till a storm strikes us and till we are quite certain about it. We have got a more exposed coast than anyone excepting the Norwegians. The north coast of Norway, from about the parallel of 60 degrees, in fact is more exposed than we are, but we have no possibility of getting intelligence till the storm reaches our outposts.

14,469. Is there any interruption to the service of reports?—We cannot get any observations on Sundays, or even if we did get observations, we could not re-issue them. The post office people all leave at about 10 on Sundays, and we should not be ready to issue our warnings or to telegraph our information down to the coast till about 11, and the offices are all closed on that day during a very long time. We are perfectly ready to begin the work here if we could do anything with it, but the information would necessarily lie in the office till Monday.

14,470. Is the information sufficient in quantity, quality, or frequency?—Not nearly for what we want. The United States get three observations a day. They get three telegrams of the state of the wind at three different hours, at each eight-hourly interval; and we only get one at most stations. For the afternoon report we want extra information, but that all means extra money. And in the same way as regards the quality, if we could get continuous self-recording instruments, we could get a better record of the actual movement of the mercury in the barometer at the moment of observation. When a man gets up in a morning he wants to know what has happened for the last three or four hours; that all implies additional money, and our photographic instruments will do nothing for us in that respect, because they require two days for the records to be developed. You see nothing on the paper until it is developed. You must have mechanical instruments for this purpose.

14,471. Can you point out to the Commission some of the most important requisites for an improved service?—Additional information as regards the commencement of a gale, the instant that the wind begins to rise or to change, especially the changes which occur at outlying stations, and which may not be exactly felt as soon at our telegraph reporting station. For instance, take Cape Clear, the wind might begin at Cape Clear some two hours before it reached Cork. Cork is our nearest station, as the gale might not affect Valencia if the thing commenced just down at the south of Cork. So that extra reports, of a simple character, of the wind would be exceedingly valuable. There is a plan devised by Mr. De la Rue for erecting small anemometers which shall ring bells, whenever they begin to move at a certain velocity, and we think that possibly at stations like a lighthouse, hardly at an island station, but on an outlying headland, we might at a moderately small expense get information of the actual commencement of a gale. Supposing I saw what the reports were this morning, I should know nothing more until 3 o'clock; the afternoon reports are only just beginning to come in at the present moment (2.30 p.m.), and there may be a gale which has commenced which was not serious enough for the man to send a special telegram, as he is ordered to do, but still the fact of the velocity having risen would give indications to us of what was going on. The idea would be that we might have automatic records of the wind transmitted to the telegraph stations by wire, and giving a signal there which would be very simple.

14,472. Has any suggestion been made for the more speedy receipt of information from the outposts?—A suggestion of this nature, which is that a simple telegram should be sent by wire to the central station.

14,473. Would that involve complicated telegrams?—No, not complicated; but it would involve an interference with the commercial telegrams, which is a serious difficulty.

14,474. Practically, then, it would be difficult to carry into effect?—We think it must be. At first objections would be raised; it would simply be a question of a demand for more money.

14,475. What systems are in practice abroad?—There are various systems of telegraphy; but we are hoping for uniformity. In fact, the Director of the Russian service, Professor Wild, and myself have devised by the direction of the Vienna Congress a code for such telegrams, and we hope to get it introduced, so as to get greater uniformity. At present I might say that the French stations do not report the rainfall, which we want to get. The Russians do not report certain things which we

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

report, from the difficulty of getting good instruments to the outlying stations in Russia.

14,476. Does the office lend barometers for public use in poor fishing villages?—A very considerable number; in fact, any place which can show that it is a port for small craft, and is poor, can get an instrument from us on condition of exhibiting it. But if a place is in any way wealthy, or if there is a wealthy landlord near it, we see what we can get him to do to put it up. There are about 300 public barometers round the coast, of which upwards of 100 belong to our office. I think every lifeboat station has a barometer from the Lifeboat Institution, not from us; but they are all the same pattern. The Duke of Northumberland also erected several on the coast of the North of England. We find that they are exceedingly liked in most cases.

14,477. Do you look after any of those barometers?—Yes, whenever I am near them; whenever I go round the coast, if I get within a mile or two of a fishery barometer station I would go to it. I would not go out of my way and take a long journey, but if a few hours would do it I should go to it.

14,478. Have they been neglected in some cases?—In some cases they have been. The Scotch ones are managed through the Fishery Board, and they look after them. In some cases we have recalled them because we found them neglected; but in most cases they are very much liked. They are mostly put up outside the Sailors' Homes or in public places where the people take a pride in them.

14,479. Do you also supply forms for registration?—Yes.

14,480. And are those made use of?—In a good number of cases they are; with most of them we supply those daily weather charts, if the people ask for them, and we supply the Barometer Manual, and various books with our instruments that we send; they are very simple publications which ordinary fishermen are likely to understand, and are sent for free distribution.

14,481. Is the subject of the weather studied to any considerable extent?—We have no funds for any thorough discussions of the history of storms and the character of storms. We have very little means for doing it. Our discussion has been simply a sort of chronicle of the weather, simply a history for two or three days of one particular storm, but not as to the origin and genesis of the storm. In fact, investigations into Atlantic weather would be the only thing which would throw a light on our own weather; but it is certainly a weak point of the office that we have not got sufficient staff to go on with it. There is a staff for the weather telegraphy and the preparation of the daily weather reports, going on from day to day, testing the accuracy of the warnings and detail work of that character.

14,482. Do you think that with a larger staff and with a larger amount of funds you could do much more in the direction of studying the weather?—Yes, undoubtedly.

14,483. Would you require additional buildings for your accommodation?—No, not additional buildings. The accommodation upon the three flats that we have in the house that we rent is sufficient. There has been one very interesting investigation into the Atlantic weather, published by Captain Toynbee, at the time that the steamer, the "City of Boston," disappeared, and most elaborate charts for eleven days have been published. We are at present collecting information to publish a similar discussion if we can of the weather during the time of the storm of last August, the great storm on the coast of Nova Scotia; but we want to see if we can get information, if the information is in existence, because everybody says that there is information in existence for the discussion of cyclones, and asks why it is not discussed. The answer that we could make to that is, that the information *is not in existence,* and that there is nothing like a sufficiency of materials.

14,484. What is your opinion as to the need of an experimental observatory?—Decidedly there is a very serious want of an experimental observatory for all sorts of experiments, such as the best mode of exposing the thermometers, the best kind of anemometers, &c., &c. Physical experiments connected with meteorology are most seriously wanted. The experiments of that nature which are carried on are only on a limited scale. There is one set of experiments carried on, by permission of the Board of Works and Doctor Hooker, at the Pagoda in Kew Gardens, on the effect of height on the thermometers by exposing them at different heights in the different storeys of the Pagoda, and that is paid for by the Meteorological Committee. I have received a grant from the Government Grant Committee to test certain kinds of anemometers; these operations are all on a small scale, but for regular investigations on an extensive scale funds are certainly wanted.

14,485. Is anything of the kind done at Kew?—To a certain extent, but very little. The money of Kew is for definite purposes. The money from the Gassiot donation has to be expended on the keeping of continuous observations, chiefly of magnetism. Mr. Gassiot's money produces about 500*l.* a year. The money from the Meteorological Office is 650*l.* a year, which is wanted for our regular work, for the work at the central observatory. The testing of the instruments pays for itself, so that there is only a very small margin for any real experimental testing. The Kew Committee lay down the work very definitely, but if extra money is supplied the work can be done. For instance, if anyone pays for work it can be done at Kew. The Indian Grand Trigonometrical Survey have sent Captain Heaviside to test pendulums there at the expense of the Indian Government, but there are no funds at Kew for originating such things.

14,486. What is your own relation to the observatory at Kew?—I am simply the secretary to the Committee. The Committee is composed of the members of the Meteorological Committee. I simply manage their minutes, and am honorary secretary, and am not paid at all.

14,487. Practically the Committees are composed of exactly the same persons?—Yes, the same persons.

14,488. What is your opinion as to the proper functions of a central establishment for meteorology?—I think that it should discuss the materials, and present the results in such a form that physicists can deal with them, but that it should not itself aim at arriving at anything but mean results; that it should not commence investigations into theoretical subjects, because that is the real difficulty. It is very difficult for an office which is responsible to Parliament to keep itself at all within bounds if it begins theoretical discussions. And besides that, it should superintend all the work through the country, but it should not itself begin to discuss and go too much into theories. I think that questions of general meteorological speculations can hardly be carried on at such an office, if it is responsible, for the work done, because you have to produce definite results.

14,489. Did I rightly understand you to say that you have to furnish materials?—Yes. We have to furnish materials, and we are always ready to answer questions.

14,490. (*Dr. Sharpey.*) Is the cost of the instruments supplied to the Navy charged to the grant of the Meteorological Office?—Entirely; and, as I stated on the last day, in the first estimate there was a sum of 570*l.* for the supply to the Navy, but after that year it was not included. It is a portion of our work to supply the Navy. All the old instruments which belonged to the Navy from all the dockyards and every place were sent in to us. The whole management of the meteorological service of the Navy is transferred to the Meteorological Office.

14,491. (*Professor Smith.*) On referring to the Report for 1870, I noticed that the greater part of the expenses of the land meteorology fall under the headings of expenses incurred at the observatories;

R. H. Scott, Esq., M.A., F.R.S.

5 May 1874.

those are chiefly your seven fixed stations, are they not ?—Yes, the seven fixed stations.

14,492. How does that money go at the different observatories. Is it in payment of salaries ?—We do not ask any questions. I mean, we say, *e.g.* to Professor Grant, at Glasgow, we will give you 250*l.* and a stock of instruments; you must furnish us with the returns, and you may pay your assistant, or do whatever you like with the money. The arrangement is with the different gentlemen, Professor Thomson at Aberdeen, and Professor Grant at Glasgow, but with the College at Stonyhurst, with the Royal Cornwall Polytechnic Institution at Falmouth, and with the Kew Committee, to do a definite amount of work for a definite pay. In Ireland it is different. Dr. Robinson says:—"I will do the work without any pay if you "will pay me all that I am out of pocket," and, therefore, we pay his assistants, and at Valencia everybody is paid by us.

14,493. Do you not receive from the Radcliffe Observatory at Oxford nearly as much information for a very much smaller payment as you receive from any one of those seven stations ?—No; we only receive from the Radcliffe Observatory one set of observations taken at 8 o'clock in the morning.

14,494. And what do you receive from the other stations ?—A great number of observations, taken at 24 different hours during the day, with the continuous records. We simply get one single set of readings from the Radcliffe Observatory. They have the continuous instruments, but they do not send us observations from them. In fact, the Radcliffe Observatory is not in connexion with us. The assistant is allowed to undertake the work of reporting to me. The Radcliffe Observatory is in no sense an observatory for the Office. It is a station for telegraphic reports, and I think the amount of payment is simply 5*s.* per week. We simply call the Radcliffe Observatory a telegraph station.

14,495. (*Dr. Sharpey.*) That is the case with the other stations which you call telegraph stations, I suppose; you get information from them at the same rate ?—Yes, at the same rate and the same amount of information precisely at 8 o'clock, and at certain stations we get it also at 2 o'clock in the afternoon.

14,496. (*Chairman.*) Is there any further point upon which you would wish to make any additions to your evidence ?—The only thing that I would venture to ask the Commission would be that as there is a good deal of responsibility attached to my position at the Office, if, in the evidence of anyone else there is any question connected with the office, which, in your opinion, would want explanation, or which bears on our action, I might be allowed an opportunity of being re-examined.

The witness withdrew.

J. Glaisher, Esq., F.R.S.

5 May 1874.

JAMES GLAISHER, Esq., F.R.S., examined.

14,497. (*Chairman.*) I believe you are chief of the Meteorological Department of the Royal Observatory at Greenwich ?—I am.

14,498. Is there any special name attached to your office ?—Superintendent of the Magnetical and Meteorological Department.

14,499. I believe you have for many years undertaken to compile certain meteorological returns for the use of the Registrar General ?—I have.

14,500. Will you be so good as to explain the nature of the system which you have organised for that purpose ?—With great pleasure. Perhaps I may state how my first connexion with the Registrar General commenced. The Registrar General had published the mean temperature at York as being five degrees higher than the mean temperature at London; in consequence of which I wrote to him, telling him of the physical impossibility of such being the case, and he then told me that he had no one in his office who could reduce the observations, and no one who could judge whether they were correct or no. Having been educated as an astronomer, and having had the meteorological department placed in my hands, I had been desirous of ascertaining the general accuracy of meteorological instruments in general use. For that purpose I had gone all over England, Ireland, and Scotland to see the best observers who were taking observations, and I found that of the thermometers the most accurate were three-tenths of a degree wrong at 32, and three degrees wrong at 90, in both cases reading too high, and that barometers were very frequently a quarter of an inch in error. Mr. Sheepshanks in the years 1840 and 1841 brought out his standard thermometer, which is still the standard, and I endeavoured to bring into general use instruments very nearly free from errors. The instrument makers then worked with me, and the consequence was, that at the time the Registrar General spoke to me I knew a large number of persons who I thought would take observations; and, knowing a good number of Cambridge men, I thought that clergymen would unite with me, and would help in establishing a system of truthful observations. Thereupon I travelled over the country and induced some 50 or 60 gentlemen of education and position to engage in the toilsome work of daily observations, and they have done so for these 30 years. I feel it a great pleasure and pride to think that I have successfully organised a system which had always previously failed. That system I have continued from that time to the present. I have had assistance from noblemen; for instance, the Earl of Leicester has always returned observations to me, and Mr. Whitbread has given me every assistance. So have several other persons, and I have been enabled for 30 years to collect observations, and furnish the results to the Registrar General. Those observations came then, and now come, to me. I have brought a sheet of observations for January, February, and March, from Dr. Hoskins of Guernsey, my most southern station (*producing a chart*). As the Commission will see, this is a sheet for Guernsey for a month. The observations come to me at the end of every month, and on the 15th day following the third month the results must be in the hands of the printer. I take Greenwich as the standard, as it has photographic registrations. Then when I have the returns I take all in or near the latitude of Greenwich, and compare the heights and look at every reading of the barometer. I then look and see whether the temperatures given during the day are larger or smaller than the maximum or minimum readings of the same day. By these means I check them to a very large extent (*explaining the sheet to the Commission*). The Registrar General publishing within a month after the close of every quarter necessitates my being ready for him, so that I have within 15 days after the quarter to send the results to him, and I have invariably done so without failure for 30 years. (*The witness produced several tables, and explained to the Commission the mode of preparing the returns for the Registrar General.*) By the means which I take it is almost impossible for me to let any great error go out to the world. The value of these tables depends on their accuracy or their inaccuracy. I keep other tables for thunderstorms in every month, for solar haloes, for lunar haloes, and indeed for all the different phenomena, which are collected together and checked in the same way. When these are done and examined by two persons they are sent to the printer. In any case of discordance I immediately write to the observer, and if my writing is not sufficient to cause the error to be corrected, I publish it as such in one of the quarterly reports, which I find to be the most effective way of obtaining the correction. By these means, as an old computer, and as one who has been well trained to calculation, I believe that I have produced tables upon the whole as accurate

J. Glaisher, Esq., F.R.S.

5 May 1874.

as any in the world. But I cannot say that absolute accuracy is attained even in the Greenwich observations, on which no time or trouble is spared; there is not a volume nor a sheet that passes me that is correct. When I receive a revise I find errors in it that did not exist in the proof, and when that revise goes to the printer after I have corrected it, it is often printed wrongly by a slip in the figures. Therefore, as typographical errors in all probability will remain, I believe it to be impossible to be quite free from error.

14,501. Are the observations taken entirely gratuitously at the different stations with which you have connected yourself throughout the country?—Entirely gratuitously.

14,502. Have you furnished in any cases the instruments that are made use of?—In some cases I have given instruments to gentlemen with small incomes; but I have given them out of my own pocket. As a rule I have not done so, and I do not wish it to be known that I have ever done so, because then other observers would want the instruments supplied to them; and, indeed, I believe that were once the Government or anyone to supply instruments, there would be such a demand that the system would break down entirely, and more than that the observers would want to be paid. In Ireland particularly, where having been engaged on the Trigonometrical Survey, I knew a good many people, I thought that I should be successful; but Irish gentlemen would not take any observations unless I furnished them with instruments, and then they would not use them without I paid them for taking the observations. Were 50 or 60 or 70 gentlemen to be paid, the amount of money required would be very great.

14,503. If they were paid in proportion to the work done, you think that the cost would be very great?—Very large indeed.

14,504. Could you state on the average what each station would be likely to cost, supposing that the work done at it was paid for?—The Meteorological Office has six stations, and you know what each of them costs. Each of the observers is paid 250*l.* a year, I believe.

14,505. Do your observers do as much as each of those under the Meteorological Office?—They do not do so much, simply because at the Meteorological Office stations they have self-recording instruments and photographic registration, and therefore more attention is required than my observers would give. I tell my observers, if they can only take one observation a day to take it, at or about the hour of breakfast, as being the most convenient time; and after some time, if they commence with one, they will generally take two. In the case of gentlemen I always wish them to train some one person in their establishment in whom they could place confidence. In many instances they employ Scotch gardeners, who are generally very intelligent men, to take the observations. All the observations at Cardington have been made by a Scotch gardener as carefully as I or Mr. Whitbread himself could make them. I have been at Cardington many times, and I have seen the observations being taken. My plan has been to go round to the stations, and read the instruments with the observers.

14,506. At all events the cost would be very considerable if the system of paying for those observations were once established?—I think it would be very large. Take a mere set of instruments, a barometer, a thermometer, a dry and wet bulb thermometer, a minimum and maximum thermometer, a maximum solar radiation thermometer, and a minimum terrestrial radiation thermometer, an anemometer, a rain gauge, and so on, these cannot all be bought for less than 20 guineas, and, besides, if gentlemen pay for their own instruments they are careful in their use. I think if Government were to pay for instruments, observers might be less careful in their use, and I think some voluntary observers would give up if Government were to interfere.

14,507. Why would they object, do not they do it because they take an interest in the subject?—Most of them take an interest in the subject, because it is my desire to find gentlemen who do take an interest in it.

14,508. Do not you think that under any system they would be willing to furnish information, owing to the interest that they take in the subject, without expecting any remuneration for it?—Some would, doubtless.

14,509. Does the management of the system entail upon yourself a considerable amount of expense and labour?—Owing to the constant correspondence I must have two assistants, and I have to train them, so that when I am away they shall be able to proceed with the work. I always endeavour to come back before the time of printing to examine it and see it. The Government allows me 150*l.* now towards the expenses to which I am subjected, but for many years I did the work free of all expense. Then I received 50*l.*, then 100*l.*, and then 150*l.* per annum.

14,510. Are you in the habit of travelling to any of those stations?—Yes; not so frequently now because I know the character of my observers. I know from their returns and I know by all that occurs that there is no occasion for me now to travel so frequently as I used to do.

14,511. Does your number of stations continue about permanent?—Yes.

14,512. Occasionally on the death of an observer who has had charge of a station have you found much difficulty in finding a successor?—No. There were two deaths last year, but I have Ramsgate and Leicester for the first time this year, and they will make up the loss of two last year. I like a change of stations because I thus get observations from another part of the country. I could increase my stations now, but I do not want to increase them beyond the number I can deal with.

14,513. Is the whole country tolerably well represented?—Yes, tolerably well.

14,514. Do you include Ireland?—No, I do not. I have only one station in Ireland. I was terribly disappointed with regard to Ireland. My stations are Guernsey, Helston, Truro, Portsmouth, Brighton, in the South, and so on, extending up to North Shields in the North. In Scotland I had several observers. I have Aberdeen still, but that is the only one. The Scottish Meteorological Society and the Registrar General of Scotland attend to them now, so that I am confined to England.

14,515. Have you any opinion as to whether, supposing you were to discontinue the duties that you have conducted for so many years, the Meteorological Office would be able to carry on the same work?—I think that the Meteorological Office or any Government office would have a difficulty. The Meteorological Office at the present moment has not the stations. The six stations that they have I would not accept the observations from. When I was at Aberdeen I found the thermometer 48 feet above the ground and close to a stone wall. When I was at Weymouth I found the thermometers badly placed, and even at Kew, where one would think all would be perfect, the thermometers are 10 feet above the ground. Now I lay it down as an absolute necessity that the thermometer shall be 4 feet above the ground, which is just the height of the mouths of men and women, and I obtain that uniform height all over the country, because unless there is an uniformity in the position of the instruments it is impossible that there should not be continual differences due to other than local causes.

14,516. The Meteorological Office, we understand, are alive to the necessity and importance of having the thermometer at the same height, but they find a practical difficulty in carrying it into effect?—Yes, to a great extent I have the same, but still I have the instruments placed as nearly as possible under the same circumstances. If I have to deal with a house in a courtyard surrounded by a wall, I may place the instruments in the centre and make the best of what it

J. Glaisher, Esq., F.R.S.

5 May 1874.

may be; but with respect to placing thermometers 48 feet above the ground to compare with results at other stations at 4, 6, or 8 or 10 feet high, I say it is impossible to compare the results together.

14,517. Do we understand that all your instruments are precisely under the same circumstances as to height from the ground?—As near as it is possible. I cannot have them identical, but I insist upon their being as nearly as possible under the self-same circumstances. It is imperatively necessary for the investigations which I have to conduct, that is to say for the Statistical Office, that the different results given should be due to local causes. That is the problem which I have to solve.

14,518. Supposing that the Meteorological Office were to undertake the duties which you at present take upon yourself, would it be necessary, in your opinion, for them to abandon any part of their present operations?—It seems to me that if the Meteorological Office attack land observations, large as their sum is, a great portion of it would be absorbed, and that they would have to lessen their work unless you were to increase very much their present allowance. Sea meteorology is that which an individual cannot attack. Sea meteorology is what we want; we want the physics of the globe. Meteorology is not yet a science, it can only be called collecting facts, and those facts now are becoming very numerous, affording data for the mathematician to use, but he is at fault for want of knowledge of the physics of the globe. We know a little of the meteorology of the sea about those tracts which the steamers make. Maury did a great deal with the little means at his command, and that which the Government must do, and which nobody else can do, is to get the physics of the globe, and until that is attained we must remain pretty nearly in the state in which we are now. Local societies and local people can investigate the climate of their districts, and do it well, and that is very important, but we cannot do individually the physics of the globe. It is proper that the Government should help in solving that problem, and what we want is a director who is a good physicist; a man who is a good mathematician, who knows how to use the results which are brought to his notice.

14,519. Would you leave land meteorology chiefly to private observers?—I would indeed, because they will do it, and do it well. They will supply sufficient information with regard to climate, and so on, and the public will have the results; but that which the Government should do is that which a man cannot approach. Whatever I have attempted with regard to the sea I have given up as beyond my power. It requires the Government to come in and attack the physics of the globe, and to get observations—just what the Government are going to do with regard to the transit of Venus. The observers will have instruments to take hourly observations with during their voyages, which will add greatly to our knowledge, because they will be passing over tracts of the ocean not usually traversed.

14,520. Would you think it right that the Government should encourage private observers, or would you leave them entirely to their own unaided efforts?—I think that the Government had better leave them entirely alone.

14,521. And not give them any assistance in any shape?—I think they had better be left entirely alone. Once give assistance, and you will check private and individual effort. My observation is based upon a long experience in that respect.

14,522. Perhaps you are aware that the Meteorological Society of Scotland do not at present take the same view, but would like a little help from the Government?—I founded the Meteorological Society of England myself, and for 25 years I was its secretary or president, and never once during that time would I allow any application to be made to the Government for help. If you do give Government aid to societies you emasculate them, you take from them their energy. The society of Scotland is a little different, because it proposes, at the request of Lord Tweeddale, certain specific investigations such as that connected with the herring fishery, a very important matter; and if a grant be made by the Government for that special object, doubtless good results will follow. But my experience with respect to societies, and I have been connected with a good many, is that Government had better not aid or control any of them. If they will not work by themselves, if the members will not subscribe sufficiently for their objects, they had better be left to die.

14,523. You are decidedly of opinion that everything that is desirable as regards extending our knowledge of land meteorology might be left to private observers?—Yes, I think so.

14,524. As a consequence of that opinion, do you hold that the operation of the Meteorological Office as regards land observations is not of very great value or importance?—I think that its operation is of no great importance, but I think it is of very high importance for the sea. I am only saying now what Admiral Beaufort said to me when Admiral FitzRoy was appointed, and in which I agreed. He said, It is of the very highest importance at sea, as no man can grapple with it. What we want is sea meteorology, and connected with ocean meteorology are the physical investigations of the globe, and that must be done by Government.

14,525. Do you hold that if the land operations of the Meteorological Committee were given up, meteorological science would not suffer in consequence?—I do not think it would; but there is one great good thing that these six stations of the Meteorological Office will do if they are well worked. They are placed here in a line, and they have got hourly observations, and in consequence of their photographic registration they will determine very shortly the diurnal range in those six parallels of latitude with a considerable degree of accuracy, and having determined the diurnal range due to any one latitude, this will become an excellent guide for observations made in or near that latitude, and will enable local observers to reduce their observations to practical results. If the diurnal range be accurately determined, observers need only take observations at 9, 10, or 11 o'clock, and in the afternoon at 3, 4, or 5 o'clock, as they would know the corrections to apply to those means, so as to deduce true values for 24 hours. It will add very much to the power of local observers. I am now engaged in reducing 20 years' photographic observations that have been made at Greenwich, and I believe that among other determinations that of the diurnal range will be one of great importance.

14,526. That could not have been obtained, could it, except through the Meteorological Office?—The photographic observations at Greenwich have no connexion with the Meteorological Office.

14,527. (*Professor Huxley.*) Did I rightly understand you to say in reply to the noble chairman, that with the exception which you have just mentioned, the observations taken at the six stations of the Meteorological Office are absolutely of no value whatever?—I did not say that. I spoke of their no great value, and one valuable thing that I would mention is, that you will have the mean temperatures under the circumstances under which they have been taken in those six observatories very well determined.

14,528. I think I understood you to say that meteorological science will suffer no loss if those six stations were abolished?—When once the diurnal range is determined I do not think it will suffer any loss by their cessation.

14,529. Then it comes in point of fact to the statement that all observations, except those particular ones to which you have referred, are of no good?—I do not say that. I say that from them you will have a good determination of the mean temperature of those stations, which is valuable, and possibly a good determination of the hygrometrical states. Do not let me depreciate them. Their chief value, as I hold, con-

J. Glaisher, Esq., F.R.S.

5 May 1874.

sists in a good determination of the diurnal range for the elements in those positions, and having determined these, it is quite sufficient to apply them as corrections all over the country.

14,530. (*Professor Smith.*) Except at such stations where public money was given you could not have photographic observations, could you?—No.

14,531. You could not expect volunteer observers to take photographic observations?—No. Certainly you cannot expect volunteer observers to do that.

14,532. What is your opinion of the importance of photographic observations made at fixed stations on land for the progress of meteorology?—At a few fixed stations I value them much. At many stations I should not value them, for I think that observations by the eye, &c., of all local causes are sufficient for the advancement of science, and would give quite as much information as we need. I believe that we obtain from many of our stations all the principal investigations of the elements, equal in value to those from the six stations, and with much more ease.

14,533. (*Professor Huxley.*) Of course at some time or other, although I hope the period will be very far distant, your own activity in this matter will probably come to an end?—Yes, certainly.

14,534. You would be very sorry, would you not, to see this system discontinued?—Indeed I should be.

14,535. It may be difficult to find a second representative, or an equivalent to yourself, who would do all this work voluntarily. In what way would you suggest that it might be continued?—I am getting old it is true, but still at the same time so long as I should be able I should like to continue that which I have founded and worked out myself; but as that time approaches I should have to speak to the Registrar General to see whether I could not get some one in his office, first of all. You are touching upon a matter about which I have not really thought very much; but I should be very happy if you have any series of questions to send to me to furnish you with answers in writing.

14,536. It would be obvious that that is a point of view from which the Government is very likely to regard the whole matter, because the question at present is between your own voluntary efforts and the action of a Government office, and of course the Government must necessarily look to the possibility (let us hope that it may be 20 or 30 years hence) when you will discontinue that work; still if the work is to go on it must be done by somebody, and unless there should be some volunteer who is willing to make the same sacrifices that you have done, of course the alternative is that the work would fall into the hands of some Government office, whether the Registrar General's or some other; but you do not seem to contemplate with much horror the possibility of its going into the Registrar General's office?—I have been so long connected with that office, and I see the officials there so apt with their figures, and so correct in their work generally, that I have no great horror of its passing into the Registrar General's office. It would be merely collecting so many facts.

14,537. Do you think that those local observers, with whom you have established those relations, would supply information to the Registrar General's office?—I am doubtful of that. I have been training them in a great measure to become accustomed to do so in order that the transition might seem to be but small. As you will observe, instead of having my name printed on the back of those papers which used always to be sent to me with my name on them, I have accustomed the observers to send them to the Registrar General's office in the manner which you will see by looking at the papers. Until very recently my name was printed on the back of the quarterly reports.

14,538. So that in point of fact at this present time the observations do go as it were to a Government office?—Yes, a large number of them. Connected with this I have weekly reports which I send to the Registrar General, and another to the Registrar General of Edinburgh, and there are several other reports, some annual.

14,539. (*Chairman.*) With respect to photographic observations, I am not quite sure whether you expressed an opinion that their permanence is not a matter of importance, but that in the course of a few years they might be discontinued without any disadvantage?—Yes; I think it is better that they should be discontinued at the six stations, because they will have done their work.

14,540. (*Dr. Sharpey.*) Did I understand you rightly, that the weekly reports are reports of the observations at Greenwich?—Not only from Greenwich. I have on every Saturday night or Monday morning a return sent to me from about 14 large towns in the country, and the results are sent by messenger every Monday morning to the Registrar General.

14,541. Are those 14 large towns part of the 49 stations that you have established?—There are some other stations; they are not the same.

14,542. Not private stations?—Yes, private stations.

14,543. Is there anything paid in those large towns for those returns?—No; I merely ask my friends to give them to me.

14,544. It is a friendly act?—Yes; the principle on which I collect observations is that the sending them is a friendly act to myself. I know that the Fellows of the Royal Society will do anything for me if I ask them. I know that of Oxford or Cambridge men; if I ever want an observer, I have only to write to them on the subject, and I generally get volunteers who will give me the observations that I want. I have a large correspondence with meteorologists, both here and on the continent, and I think I can get almost from any part of the country any information I may wish.

14,545. My reason for asking is, that the Astronomer Royal, in a letter which he caused to be written to the Government, states that weekly observations were furnished from Greenwich free of expense?—Yes, they are furnished from Greenwich free of expense.

14,546. You furnish them to him, and he supplies them to the Registrar General?—No; we have supplied from Greenwich from about the year 1843 a weekly return to the Registrar General, based only upon the Greenwich observations. Then when the Registrar General publishes, as he has done lately, the weekly statistics of any new town, I write to somebody that I know to send me week by week information of the meteorological conditions to publish with his returns.

14,547. That is in addition, is it not, to the returns from Greenwich?—Yes, that is in addition to the Greenwich returns. The Greenwich return has always been sent from the observatory at Greenwich to the Registrar General free of all expense, as it necessarily would be from one Government office to another Government office. The comparison of the reports is one of those things that tie me there on a Monday morning until I can write out the report. The Registrar General sends down at 1 o'clock every Monday, and by this time I must have it ready.

14,548. (*Chairman.*) Are there any other points upon which you think it desirable to give your opinion to the Commission in connexion with this subject?—No. I was not quite well aware when the letter from the secretary came to me as to the nature of the evidence that you required, nor indeed when I came to-day was I aware of the nature of it.

14,549. It was in consequence of the correspondence which had taken place that we asked you to come.—I should be very happy to give any information to the Commission. If it occurs to you that you think my experience of any value, I shall be very glad to give it at any time that you might wish. I should like, as I have said before, if the Commission could use its great influence to get the physical meteorology of the globe undertaken by the Government, because it must

J. Glaisher, Esq., F.R.S.

5 May 1874.

be done by the Government if at all, and we are stuck fast in a great measure until we get information from parts of the earth where we have now no observations.

14,550. Are there any branches of meteorology to which you think the Government ought to apply itself which are not at present included in the operations of the Meteorological Committee?—I think that the extension of sea meteorology might very well be undertaken.

14,551. What measures would you recommend to be taken that are not taken at present. Would it be anything of a different nature from what is at present done?—No. At present we get information mainly from those parts of the sea which are the tracks of steamers or the tracks of other vessels, and we get it constantly repeated; but that which we want is, so far as the Government can afford it to us, the opportunity of getting useful observations on parts of the earth's surface of which we are at present ignorant.

14,552. Do you think that expeditions ought to be sent out expressly for that purpose?—I think that is rather too expensive. I would suggest that we should avail ourselves of every opportunity of getting observations wherever expeditions are sent.

14,553. Have any opportunities of that kind been neglected?—I do not know that any have been.

The witness withdrew.

Adjourned.

No. 6, Old Palace Yard, Westminster, Tuesday, 12th May 1874.

PRESENT:

HIS GRACE THE DUKE OF DEVONSHIRE, K.G., IN THE CHAIR.

SIR JAMES PHILLIPS KAY-SHUTTLEWORTH, Bart.
WILLIAM SHARPEY, ESQ., M.D., F.R.S.
THOMAS HENRY HUXLEY, Esq., LL.D., Sec. R.S.
GEORGE GABRIEL STOKES, Esq., M.A., LL.D., Sec. R.S.
HENRY JOHN STEPHEN SMITH, Esq., M.A., LL.D., F.R.S.

Deputation from a Committee appointed to promote the Extension, &c. of the University of Edinburgh.

12 May 1874.

A Deputation from a Committee of the general public appointed to promote the extension and improvement of the buildings of the University of Edinburgh,—consisting of Principal Sir ALEXANDER GRANT, Bart., Professor WILSON, Professor TURNER, and Mr. R. BRUCE JOHNSTON, Secretary, and accompanied by the Right Hon. LYON PLAYFAIR, C.B., M.P., waited upon the Commission.

(*Chairman.*) We have already received a good deal of evidence with respect to the wants of the University of Edinburgh, but as we understand that in the meanwhile the subject has been further considered in the University, and public opinion may possibly have assumed a more definite shape than at the time the witnesses from the University were examined, we shall be very glad to hear any statements that you may have to make upon the subject.

(*Sir Alexander Grant.*) My Lord Duke, we attend as a deputation from a Committee, of the public in general, that has been formed in Edinburgh to endeavour to remove the great disabilities which at present exist in the University of Edinburgh. A statement has been drawn up of the objects which this Committee has in view. That statement contains, of course, matter which is external to your Grace's Commission, that is to say, the giving of the University a hall and other things besides scientific buildings. I will limit myself to one or two extracts from the appeal which has been drawn up, and which will be entirely confined to the scientific wants of the University.

The facts of the matter are these: 100 years ago, or thereabouts, the buildings of the University were found to be utterly inadequate; and the people of Edinburgh felt that, and then they took a similar action to what they are taking now, and they caused meetings to be held, the matter to be inquired into, and a public subscription to be collected. The public subscription gradually amounted to the sum of 30,000*l.*, and the Government supplemented that by the sum of 129,000*l.*, and out of that money, 159,000*l.*, the present College buildings of Edinburgh were erected. They were only finished I think about the year 1810, or, at all events, within the first 20 years of the present century. The cost of the site and buildings did not completely expend the sum, because the Commissioners who were appointed by the Government to superintend and arrange for the buildings at the time bought for the purpose more land than was built over. That superfluous land lay to the west of the present College buildings, and afterwards, when the Industrial or Science and Art Museum came to be erected in Edinburgh, the land which had thus been bought for the University was handed over by the Town Council, who were then the patrons of the University, to the Government for the purpose of building this Museum upon it. And thus the Science and Art Museum of Edinburgh is built to a certain extent on land which properly belonged to the University of Edinburgh, and which would certainly have been used by the University at the present moment if it were still in our possession. I may add that the building of that Museum necessarily, to a considerable extent, impeded the use of the parts of the University buildings which lie on that side. The lights was entirely excluded, and one face of the building was darkened, and, in fact, a considerable part of that building has been thrown out of use. That was the history of the present buildings, which were finished early in the present century.

The number of students for which the buildings were originally asked was between 600 and 700, and the number of professors was then 21. At present the number of students is far over 1,900, and the number of professors is 35, and two additional professors have been appointed or are on the eve of being appointed, and they will require additional accommodation.

But apart from the insufficiency of space which is thus indicated, we have had our attention long directed to a change which has taken place in the manner of scientific teaching, that is to say, that since those buildings were erected the whole subject of Practical Chemistry has been added to the course of study. I believe that the study of Practical Chemistry was first introduced into the Medical Curriculum in the University of Edinburgh, but the accommodation is totally inadequate for conducting such a study. The same may be said of the teaching of Anatomy, about which my friend, Professor Turner, will be able to give your Grace some further information. But it is well known that since the buildings were erected, there has been a considerable change in the idea of the way in which Anatomy should be taught; so that now complete practical instruction in it is thought necessary for every Anatomical Student. But the dissecting rooms at the disposal of the professor are absolutely in every way inadequate for such teaching. The same may be said of the course of teaching of Natural Philosophy, for which there is no proper laboratory in the present University. The chairs of Materia Medica, the Institutes

Deputation from a Committee appointed to promote the Extension, &c., of the University of Edinburgh.

12 May 1874.

of Medicine, Natural History, and Pathology, all require great additional accommodation, especially in the way of laboratories and room for scientific specimens for exhibition. At present, hardly any class room is enjoyed by one professor alone. They all have to be used twice over in the daytime by professors of different subjects. Necessarily, great inconvenience arises from this, the proper ventilation of the rooms is rendered more difficult, and anything like a permanent exhibition of specimens and diagrams is, of course, rendered very difficult also.

On these and many other grounds, the friends of the University of Edinburgh took up the matter some time ago. The late Sir David Baxter took great interest in the subject, and he bequeathed us a sum of 20,000*l.* towards making new buildings for the University. A Committee was then appointed, public meetings were held, and including the sum bequeathed by Sir David Baxter, which was reduced by the legacy duty to 18,000*l.*, we have already, by appeals to the public, and through the munificence of individuals, raised the whole sum of 60,000*l.* We have now promised, and we have in fact at our disposal, more than 60,000*l.* The deputation came to London to endeavour to raise some of the additional 40,000*l.*, which will be required to make up the large sum which, under the circumstances, we have ventured to ask from the liberality of the general public.

We have as yet, of course, made nothing but the vaguest estimate of what will be required, but estimating it in a vague way, we think that about 150,000*l.* or 160,000*l.* will be required for what we propose. And this is a summary of our proposals: 1st, to purchase the site of Park Place, Teviot Row. These are localities in the immediate vicinity of the new Infirmary, and that was the reason why this site was chosen. They are also not far removed, perhaps 300 yards, from the University. Of course, had the land which I before referred to been still in the possession of the University, and not been handed over to the Museum, part of that outlay might have been obviated; but we have already expended 33,000*l.* on the purchase of a site. The *second* proposal is to erect on this site, in the immediate vicinity of the new Royal Infirmary, complete class rooms, theatres, laboratories, and museums, with the latest scientific improvements, for the Medical Faculty of the University of Edinburgh. Then, having thus removed the whole of the Medical Faculty from the present College buildings, we propose, *thirdly*, to reorganize the existing class rooms of the College, and to improve them in direct adaptation to the wants of the several professors in the Faculties of Arts, Law, and Theology. The *next* proposal may still be considered to come within the scope of your Grace's Commission, and that is, that we consider it necessary to provide increased and more convenient accommodation for the University Library. The *fifth* proposal is, perhaps, not one which your Grace would feel so much interest in, although it is of the highest necessity for the University, namely, to erect an University hall for the conferring of degrees, and the holding of examinations, and for all public ceremonials. The *sixth* proposal is to improve to some extent the north front of the present College building. These, my Lord Duke, are the proposals which we have in view, and we trust that we shall get evidence of the feeling of the public, that those proposals are good and necessary, by the fact that they will subscribe for them no less than 100,000*l.*; and we trust that your Grace may be able to recommend that the Government will on its part provide what else may be necessary for giving the University proper buildings for scientific instruction.

(*Chairman.*) I imagine that your views of what is required have become somewhat more extended since the time when some of your professors gave evidence to the Commission two years ago. I think at that time it was thought that all that was required was new buildings for teaching Anatomy and Chemistry, and that every other department might be provided for in the existing buildings. I think I understand from what Sir Alexander Grant has now said, that the wants of the University are more extensive than that.

(*Sir Alexander Grant.*) Certainly, we feel very strongly that we want more than that.

(*The Right Hon. Lyon Playfair.*) Perhaps your Grace will allow me, as an old professor of a scientific subject, that of Chemistry, to mention how this necessity has arisen. There has been a great disposition in Edinburgh, and in fact in almost all teaching institutions, to develope much more the practical laboratories connected with the institutions. The accommodation for the laboratories of Physics, Chemistry, Physiology, and Anatomy, has become utterly unadapted to the wants of modern science. And the reason that it was supposed it would be a convenient thing to take the Medical Faculty out to the new proposed site is that the Infirmary is the natural laboratory of the medical profession, and it would be desirable to take along with that the laboratories, which now exist in a very imperfect form, of Chemistry, of Physiology, of Materia Medica, and of practical instruction in Anatomy, and then to develope in the present College an efficient laboratory of Physics. The main object which the promoters of this subscription have in view is to develope the teaching of science in all directions in the University. And thus it is with a view of having laboratories of research and laboratories of instruction that this movement is mainly taking place; and from the expenditure which has been made on laboratories in other directions, both on the Continent and in this country, we feel that the sum of 150,000*l.* to develope the efficient practical teaching of the University is not greater than would be required if we are to put the University of Edinburgh in an equal position with modern Universities in this respect. The main purpose is to develope the practical teaching through the laboratories of the University.

(*Chairman.*) Your view is to raise 100,000*l.* from private sources, and ask Government for 50,000*l.* more?

(*Mr. Lyon Playfair.*) Yes, that is it.

(*Chairman.*) Would that include the provision of apparatus?

(*Mr. Lyon Playfair.*) I am afraid it would not include the provision of apparatus, nor would it include the increased expenditure which would be incurred for assistants, and the various expenses that are incurred by such large buildings; but at the same time I think we may hope for private munificence to aid us in those respects as soon as the wants are clearly made known to the public, if we get the material aid of the Government in our buildings.

(*Chairman.*) We are to understand that your application to the Government will simply be for this 50,000*l.*, and nothing more whatever.

(*Sir Alexander Grant.*) We hardly limit ourselves to that. We hope that the Government will do all that is required to put the scientific teaching upon a thoroughly efficient foundation.

(*Chairman.*) You do not ask for an annual grant of any kind?

(*Sir Alexander Grant.*) That is not the nature of our proposal.

(*Chairman.*) I think that at present the Government provide something like 1,300*l.* or 1,400*l.* towards the stipends of certain professors?

(*Professor Turner.*) I do not remember the exact sum, but the particulars are stated in my evidence as given two years ago.

(*Mr. Lyon Playfair.*) I think it might be as well to mention to your Grace that in the Act of Union, when the Scotch Parliament was merged, the people of Scotland took great care to insert in the Act that the protection of the Scotch Universities became an Imperial duty; we consider, therefore, that we have a fair claim upon the Government, as it was particularly stipulated that the Universities of Scotland should become an object of Imperial care as soon as the transference took place.

Deputation from a Committee appointed to promote the Extension, &c., of the University of Edinburgh.

12 May 1874.

(*Professor Turner.*) Perhaps your Grace would allow me to say that this scheme for the extension of our University buildings is not to be mixed up with the requirements of the University as regards additional grants for assistants and for apparatus. The additional grants for assistants and apparatus would require an annual expenditure and an annual allowance from the Government: but our wants on these points I submitted to the Commission in my former evidence. The scheme which we now submit to your Grace is for the investment of a certain sum of money in stone and lime.

(*Dr. Sharpey.*) Not as an equipment of laboratories, providing apparatus and fittings?

(*Professor Turner.*) Yes, fittings certainly, but not apparatus.

(*Professor Wilson.*) Our present material would be transferred to the new buildings. I may mention that of late years our numbers have been increasing with a gradual ratio. For the last four or five years our increase has been between 80 and 100 every year, and I hope it will continue so. We have nearly 2,000 now, and therefore we have to provide for increasing wants and increasing accommodation.

(*Dr. Sharpey.*) Of course, as you have already remarked, the whole system of teaching science has been greatly extended by the extension of the practical teaching; that of course requires further accommodation?

(*Professor Wilson.*) We are really now crowded to the utmost extent—we cannot strain our accommodation any more. We have got two new Chairs to provide for speedily, and I do not know how we shall accommodate them, because our class-rooms are already incumbered with three, and one even with four, professors, which is excessively bad for the students as well as for the professors.

(*Chairman.*) I think the Professor of Geology complained very much that he was obliged to lecture immediately after the room had been used for another purpose.

(*Professor Wilson.*) Yes, we cannot arrange the professors' classes according to anything like an affinity of subjects.

(*Mr. Lyon Playfair.*) Every scientific class has recently attempted, as far as the resources of the University would go, which are very limited, to connect practical teaching with the work of the class. Even Geology is now to a certain extent taught practically. The mineralogical part is not nearly so practical as it could be if we had proper space, and the means of studying the minerals; but geological excursions are regularly made. Botany, of course, is taught practically, and there is also a great disposition to teach every science practically in the University, if we had only the means to do it.

(*Professor Turner.*) During the past six months a most valuable mineralogical collection has been given to the University which belonged to the late Mr. Brown, of Lanfine, who had one of the best private mineralogical collections in the country; but we have really no proper place to show it in. It cannot be used for teaching purposes for the simple want of space to put the cases in.

(*Dr. Sharpey.*) Does not that go into the Industrial Museum?

(*Professor Turner.*) No, it is given expressly to the University.

(*Professor Smith.*) Are you of opinion that if you remove the medical classes and the medical lecture-rooms to the new site, you will have room on the old site for all the purposes to which you have referred?

(*Sir Alexander Grant.*) I think we should, for the adequate teaching of the other Faculties of Arts, Law, and Theology. We should have to provide an examination hall somewhere. At present the only place where we can possibly hold an examination is in the library hall of the University, which is a place filled with valuable and extremely rare books, and busts of former professors, and of persons connected with the University; and it is a very great inconvenience that this handsome hall should be invaded many times a year by the examinations of 300 or 400 students at a time. You can very well understand that it disfigures the appearance of the hall; it produces a great deal of dust, and people who wish to give their treasures to the University are considerably deterred by seeing the hall in this position.

(*Mr. Lyon Playfair.*) The chief laboratory which would be left in the old buildings is the Laboratory of Physics, and considering the little money that has been spent upon that, it has been spent very judiciously. We have an excellent collection of physical apparatus. We have been lately attempting to get a good working Physical Laboratory; even now there are a considerable number of people working in it under very disadvantageous circumstances. But one is ashamed to allow any stranger to see our collection of instruments. They are all piled one up above the other, and so crowded together that the professor can scarcely move through his laboratory. The Professor of Physics would chiefly be the one who would be accommodated by the relief in space through taking the other laboratories away. The whole of Chemistry, and also the whole of Physiology and Anatomy, would go to the new buildings.

(*Professor Wilson.*) Both this session and last session the Professor of Physics was obliged to refuse certainly an equal number to those that he was able to admit of students wishing to go into the practical laboratory, simply because there was no possibility of accommodating them.

(*Dr. Sharpey.*) Do you contemplate moving the anatomical museum?

(*Professor Turner.*) We do contemplate moving the anatomical museum. We have a very fine collection of specimens of comparative anatomy, which, as far as regards teaching purposes, are at the present time almost unavailable, because the museum space is so crowded with specimens that there is not room for the students to move to and fro with safety to the preparations.

(*Professor Smith.*) As it is clearly admitted that increased laboratories would imply increased annual expenses, especially for the payment of demonstrators, I should be glad to know whether the gentlemen from Edinburgh really consider that it would be possible for them, without an annual grant from the Government, from the resources of the University itself, to supply those additional annual expenses?

(*Sir Alexander Grant.*) We have a general fund from the University, which consists chiefly of fees for graduations and for matriculation, and we administer that fund in supplying as well as we can the current expenses of the University; I may say with regard to that fund that we live in faith, and as we have hitherto been spared anything like insolvency, we trust that in the future we may, by some means or other, whether by private assistance or by grants from the Government, be able to continue in the same course, but we have not entered on that question. The public has offered to make this effort of providing materials—buildings for us, but as to the best employment of them afterwards, we have not yet entered into that question.

(*Mr. Lyon Playfair.*) I think that the Principal could very safely say that the present amount of the general fund of the University is not sufficient to meet the expenses of the new laboratories, and that resources of some kind must be found, whether they are from the Government or from private generosity, as the general fund is not sufficient at present.

(*Professor Huxley.*) I should like to ask whether the arrangements in the new chemical laboratory, which as I understand is going into the new buildings, are made with regard to the wants of the medical students chiefly, or whether there is ample provision there for a general chemical course.

(*Professor Turner.*) It is intended to make ample provision for all classes of students. Of course our medical students, being so numerous, constitute the principal attenders on the class of Practical Chemistry,

Deputation from a Committee appointed to promote the Extension, &c., of the University of Edinburgh.

12 May 1874.

but their course of Chemistry is a special one, and for their special instruction a special room will have to be provided. But, in addition, it is intended to provide a general laboratory with the most improved fittings and arrangements for all students of Chemistry, whatever their intended profession may be.

(*Professor Huxley.*) And will the physical laboratory which will be left in the old buildings be similarly provided with accommodation for thorough physical pursuits?

(*Professor Turner.*) The rooms adjacent to the small physical laboratory are my anatomical rooms, which Professor Huxley is acquainted with; and they are so situated that Professor Tait feels that there would be no difficulty in fitting them up for his purpose. My rooms are on the same floor as his apartments, and it would be an easy matter to make a doorway of communication between his present apartments and my rooms, and to fit up the rooms now occupied by me for his purposes.

(*Professor Huxley.*) Can the solidity be given to the floor which is requisite for the physical laboratory?

(*Professor Turner.*) I have no doubt as to that. The building is a solid substantial building.

(*Professor Huxley.*) There is now, I think, a science degree given by the University of Edinburgh?

(*Professor Turner.*) The University has given a science degree for several years.

(*Professor Huxley.*) And those arrangements will enable the students to pursue their studies with reference to that degree?

(*Professor Turner.*) Yes.

(*Mr. Lyon Playfair.*) Professor Huxley raises a very important issue in his questions. The chemical laboratory, as Professor Turner has explained, consists of two parts, one for the training practically of medical men in such subjects as testing, which chiefly come under their notice; but the other laboratory, which is a laboratory of investigation and of general training in chemistry, consists almost entirely of non-medical students, and of course in the new buildings it must be kept in view that the main laboratory of instruction and research is much more adapted to non-medical students than to medical students.

(*Professor Turner.*) We have that clearly before us.

(*Dr. Sharpey.*) Can the expense of assistants in any way be provided through the fees of the students?

(*Professor Turner.*) Only by withdrawing from the incomes of the professors.

(*Dr. Sharpey.*) I mean by adding to the fees of the students; has that occurred at all?

(*Professor Turner.*) The question of adding to the present fees has been mooted, but it might be doubtful whether it would be a wise course to resort to.

(*Mr. Lyon Playfair.*) Practically, the fees are much lower than they are in London or in England generally; but whether the students of Scotland are able to pay any larger fees is doubtful; and it would be a great question whether it would be advisable to raise considerably the fees for practical instruction.

(*Dr. Sharpey.*) Of course it would be a great deal better if provision for assistants were obtained in another way; there is no doubt about that.

(*Professor Wilson.*) But we do pay small salaries to a great many assistants out of the General University Fund. Whenever we happen to have a little surplus at the end of the year, we devote it to the most useful purposes, and one of those purposes has been the payment of certain assistants.

(*Mr. Lyon Playfair.*) We have now only to thank your Grace and the Commission for the kind attention which you have given us.

The Deputation withdrew.

APPENDICES.

LIST OF APPENDICES.

PAGE

APPENDIX I. (See Question 7229, Minutes of Evidence, Vol. I.; Appendix xv. Vol. I.; and *Fourth Report* of this Commission.)

The Botanical Collections at Kew and at the British Museum: Communication from Mr. Carruthers. - - - - - - - - - 1

APPENDIX II.

Correspondence between the Treasury and the Registrar-General relative to certain Meteorological Returns furnished to him by Mr. Glaisher - - - - - 2

APPENDIX III. (See Minutes of Evidence, Vol. III., pp. 6, 8, 9, 10, 11, 48, and 51.)

The Meteorological Office: Supplementary Evidence in the form of a Communication from the Director - - - - - - - - - 5

APPENDIX IV.

Resolutions passed at the Last Meeting of the Commission - - - - - 6

APPENDICES.

APPENDIX I.

The BOTANICAL COLLECTIONS at KEW and at the BRITISH MUSEUM.

COMMUNICATION from MR. CARRUTHERS.

British Museum,
MY LORD DUKE, 29th March 1875.

As Dr. Hooker and Messrs. Bentham and Ball were requested by the Commissioners to explain statements made in the communication I had the honour to submit, and as they apparently corrected or contradicted the said statements, I expected that I should also have been invited by the Commissioners for explanations of their statements.

I regret I had not such an opportunity before the Commissioners prepared their Report, as these explanations would have modified some of the statements, as of fact, contained therein; but, as I conceive they ought to be in possession of those who will be called upon to take action on the Commissioners' Evidence and Reports, I communicate them in order that they may be included in the next publication of the Commission.

I am, &c.,
To His Grace (Signed) WM. CARRUTHERS.
The Duke of Devonshire, K.G., F.R.S.
&c. &c. &c.

Referring to the communications of Dr. Hooker and Messrs. Bentham and Ball printed on pages 26 to 29 of the *Fourth Report of the Royal Commission on Scientific Instruction and the Advancement of Science*, I beg to submit the following statements:—

I. As to Dr. Hooker's Statement regarding the Herbarium at Kew before the appointment of Sir W. J. Hooker, to the following effect:—"From what I recollect myself, " and from what Sir W. J. Hooker told me, I believe that " it was, for the period, extensive, that it was arranged " chiefly according to countries, and was in part, at any " rate, classified, and well named," l. c. p. 26; I assert, from data which I shall adduce as I proceed, the following facts:—There were two Herbaria: 1, the private one of Mr. Aiton, which was kept at his own house; and, 2, the Herbarium collected by Bowie and Cunningham, which was accommodated in a room in the Gardens. 1. Mr. Aiton's Herbarium consisted of (*a*) garden specimens, (*b*) a small alpine collection made by Schleicher in Switzerland, and (*c*) a small series of British plants collected by Teesdale. This Herbarium was retained by Mr. Aiton when his connection with Kew Gardens ceased, and was sold by Foster and Son in 1851 with his other effects. I have the catalogue of this sale in my possession. 2. The Bowie and Cunningham Herbarium was collected by these botanists in their joint or separate expeditions as " Botanical Collectors to His Majesty." Some years after Sir W. J. Hooker became Director of Kew Gardens, this Herbarium was sent to the British Museum, and was placed in a cabinet, where it remained untouched until some time after I was appointed Keeper of the Botanical Department. I am, therefore, able, from my own knowledge, to speak of this Herbarium. It was arranged in three sections, South American, African, and Australian. I am intimately acquainted with the African portion, which is being incorporated with the general Herbarium, and I have carefully examined a large portion of the South American and Australian portions, and I am able to say that the whole was very imperfectly named and only approximately classified, and that it never could have been of any use in naming plants in the Gardens. But I have further the testimony of Mr. John Smith, who, according to the *Report* of Dr. Lindley, quoted in the *Fourth Report* of the Commissioners, was responsible for the names of the Garden plants, that he received no assistance whatever in this work, either from the small Herbarium of Bowie and Cunningham in the gardens, or the private Herbarium of Mr. Aiton, kept in his own house. I regret that my suggestion that Mr. Smith should be examined was not adopted by the Commission, as his testimony would have been most important in regard to matters of fact, to which he alone can speak from personal knowledge.

From facts which have come to my knowledge since I wrote the paper printed in the first volume of the Evidence taken before the Commissioners, I wish to modify the statement therein made that "no Herbarium of any kind, " I believe, existed at the Gardens during their (the " Aitons) time." (Appendix XV., Vol. I., p. *43*.) I was aware of the private Herbarium in Aiton's house when I wrote this, but not of the collections of Bowie and Cunningham accommodated in the Gardens. As they were, however, of no use for garden purposes, the argument of my paper is unaffected by this modification.

II. Mr. Bentham calls in question my personal experience of the Botanical Museum and Herbarium at Kew, because he has no recollection of seeing me there. If Mr. Jackson or Professor Oliver had borne this testimony, it would have been to the purpose. They are the officers in charge of these establishments, and their testimony, which would have been somewhat different from that of Mr. Bentham, would have been of value. I would, however, say further, that whether Mr. Bentham's memory or observation is at fault I cannot tell, but I have had the pleasure of seeing him at the Herbarium at Kew.

Mr. Bentham ventures to correct my statement, made, as he thinks, from ignorance of the Kew Collections, that Sir W. J. Hooker had no "*public* Herbarium at Kew till 1855," by stating that he used "his own *private* Herbarium!" My statement was based on the Official Reports for 1853 and 1854 of Sir W. J. Hooker to the First Commissioner of Her Majesty's Works, in the former of which he says, "Kew had hitherto possessed " no Herbarium or Hortus Siccus, the invariable accom- " paniment of every Botanic Garden abroad, and no " Library save the small practical one for the use of the " gardeners, but by gifts it is endowed by both;" referring to the bequest of Dr. Broomfield's, and the gift of Mr. Bentham's Herbarium and Library. And in the latter he says, " till 1853 our Garden was utterly destitute of the two former appendages," viz., Herbarium and Library.

Mr. Bentham may have presented his Herbarium for the use of Scientific Botanists, but Sir W. J. Hooker, as the above extracts and other Reports testify, accepted it as an appendage to the National Botanic Gardens for "naming, arranging, and ticketing the specimens."

In reference to Mr. Bentham's correction of the date when his Herbarium and Library were presented, I have to say that the year given by me was obtained from the Official Report of the late Sir W. J. Hooker for the year 1855.

III. Mr. Ball calls in question my right to state that "everything that became National property in 1827 is still "in the Collection," unless I have verified, specimen by specimen, the tens of thousands of specimens in the Museum. Were this the only possible premise on which my assertion could be based, Mr. Ball would be justified; but I had other and more satisfactory data, which I am ready to state and substantiate at any time.

Appendix II. to Fourth Report, p. 28.

I venture to submit that Mr. Ball should not be allowed to print such charges as are contained in his letter of 28th November 1872, without being required to substantiate them. I deny that there is any foundation of truth for these statements; and until he specifies some of the "large " accumulations of collections" that "were extensively "attacked by insects," I have a right to believe that such assertions have no more foundation than the equally sweeping accusation against the Museum made in his Evidence in chief [Qu. 7229]. In that instance, when I demanded from him the case on which his assertion was founded, he informed me that "from inquiries made "within the last two days, I am led to believe that the "impression under which I spoke was incorrect." Instead of withdrawing this admitted erroneous statement, he tries to strengthen his position by making further equally objectionable and baseless assertions.

I venture to express the belief that whatever action is taken on the Evidence and Reports of the Commissioners will be based on the facts adduced in evidence, and not on the opinions of partisans whose strong assertions have not been and cannot be supported by facts.

WILLIAM CARRUTHERS.

29th March 1875.

APPENDIX II.

CORRESPONDENCE between the TREASURY and the REGISTRAR GENERAL, relative to certain METEOROLOGICAL RETURNS furnished to him by MR. GLAISHER.

1543.

SIR, Whitehall, February 26, 1874.

I AM directed by Mr. Secretary Cross to transmit to you, herewith, a copy of a letter received from the Treasury, with enclosed correspondence between that Department and the Registrar General, as to the employment of Mr. John [James] Glaisher in compiling certain Meteorological Returns; and I am to request that, in laying the same before the "Aid to Science Commissioners," you will draw their special attention to the grant made to the Committee appointed by the Royal Society to conduct Meteorological Observations and Experiments on behalf of the Government. (See Civil Service Estimates, Class IV., Vote 6.)

I am, &c.

The Secretary to the Aid to Science Commission. A. F. O. LIDDELL.

1543/151. Treasury Chambers,

SIR, February 24, 1874.

Copy of 20,391/68, enclosure, and Treasury reply

Copy of 13,926/72 and reply.

Copy of 14,808/72 of 17,087/72 and nclosures, with reply.

Copy of 18,248/72 and reply, and of 2,200/73, and enclosures and reply.

I AM directed by the Lords Commissioners of Her Majesty's Treasury to transmit to you copies of the enclosed correspondence between this Board and the Registrar General, as to the employment of Mr. John [James] Glaisher in compiling certain Meteorological Returns, and I am to request that you will move the Secretary of State to cause them to be transmitted to the "Aid to Science Commission," with a view of drawing their special attention to the grant made to the Committee appointed by the Royal Society to conduct Meteorological Observations and Experiments on behalf of the Government. (See Civil Service Estimates, Class IV., Vote 6.)

I am, &c.

(Signed) WILLIAM LAW.

The Hon. A. F. O. Liddell.

SIR, December 28, 1867.

UPON more than one occasion I have brought under the notice of the Lords Commissioners of Her Majesty's Treasury the advantage I derive from the labours of Mr. Glaisher in obtaining the results of Meteorological Observations from different parts of England and Wales.

They are published in my Weekly, Quarterly, and Annual Returns; 57 publications every year.

The interest of these returns in the eyes of many of the public is greatly increased by making known the results of these numerous observations, deduced by so scientific a man as Mr. Glaisher.

But his labour is *enormous*, as is evinced by the two specimens of my Weekly and Quarterly Returns, which I now enclose for their Lordships' inspection (see pages 402 and 403 and 408 of Weekly, and pages 6 and 18 to 26 of Quarterly).

I also now enclose a copy of a letter I have lately received from Mr. Glaisher, and I will thank you to ask their Lordships' sanction to my paying in future to Mr. Glaisher out of the funds voted by Parliament for the contingencies of this Office 200*l*. 0*s*. 0*d*. per annum, instead of 100*l*. 0*s*. 0*d*., the first of such payments to be made at the end of this current year.

I have, &c.

(Signed) GEORGE GRAHAM,

To the Secretary, Registrar General.
Treasury, Whitehall.

MY DEAR SIR, Blackheath, August 15, 1867.

SINCE the year 1844 I have at the end of every quarter forwarded to you the results of carefully made Meteorological Observations collected from different parts of the country.

A sum of 50*l*. was allowed for several years towards the expense of reducing the observations and the deduction of results.

Two years since, on the addition of weekly returns for several large towns, the annual sum was increased to 100*l*., but these returns necessitate my employing a competent computer to deduce the results, and to proceed with the work during my absence.

The work of necessity occupies a good deal of my time, for which I am not remunerated; may I ask you to increase, if you can, the annual allowance to 200*l*.

I am, &c.

The Registrar General. (Signed) JAMES GLAISHER.

20,391. Treasury Chambers,

SIR, February 7, 1868.

WITH reference to your letter of the 28th of December last, I am directed by the Lords Commissioners of Her Majesty's Treasury to state that the subject of Meteorology generally, and Meteorological Observations, has been placed in the charge of a Committee of the Royal Society, and that a sum of 10,000*l*. is to be inserted in the Estimates, with the view of enabling them to carry out the objects assigned to them, in communication with the Board of Trade.

My Lords are inclined to think that the arrangements for reducing the Meteorological Observations for the purpose of publication in your Returns might be transferred to the Committee of the Royal Society, and form a part of their business, and my Lords suggest that you should place yourself in communication with the Committee, and make a further report to this Board.

In the meantime, however, my Lords would be sorry that the public should be deprived of your publications with the deductions of Mr. Glaisher, and they will not object to his remuneration being increased from the present rate of 100*l*. a year to the rate of 150*l*. a year, to be paid out of the contingencies of your Office, until it can be ascertained whether any arrangement can be made with the Meteorological Department.

I have, &c.

(Signed) GEO. A. HAMILTON.

The Registrar General.

1160. Exchequer and Audit Department,
Somerset House, London, W.C.

SIR, August 30, 1872.

I AM directed by the Comptroller and Auditor General, with reference to the second paragraph of a letter addressed by the Lords Commissioners of Her Majesty's Treasury to the Registrar General, on the 7th February 1868, to transmit for their Lordship's consideration a copy of a letter dated 10th August 1872, sent by the Registrar General to this Department, relative to his continued employment of Mr. Glaisher upon Meteorological Observations.

I have, &c.

(Signed) C. MALLET.

R. R. W. Lingen, Esq., C.B.

1092. General Register Office, Somerset House,

SIR, August 10, 1872.

As requested in your letter of 25th July, I now transmit copies of the correspondence between the Lords of the Treasury and myself respecting Meteorological Reports furnished to me by Mr. Glaisher.

I have had no correspondence on the subject with the Meteorological Society that I can recollect, nor have I acted upon the suggestion made by the Lords of the Treasury, on 7th February 1868, that I should communicate with the Royal Society, being unwilling that the public should be deprived of the deductions, of Mr. Glaisher to which they have been accustomed for many years in my Weekly, my Quarterly, my Annual Reports, 57 in number annually, and being certain that the Royal Society would not furnish me with Meteorological Observations so complete and so punctual as I invariably, without delay, receive from Mr. Glaisher.

I have, &c.

(Signed) GEORGE GRAHAM,

To the Secretary, Registrar General.
Exchequer and Audit Department,
Somerset House.

13,926. Treasury Chambers,
SIR, September 16, 1872.

IN forwarding to you the enclosed copies of correspondence for such further explanation as you may wish to offer, I am directed by the Lords Commissioners of Her Majesty's Treasury to express to you the surprise with which my Lords learn that you read their letter of February 7th, 1868, relative to the payment of Mr. Glaisher, for the preparation of Meteorological Records, as conveying more than a provisional and limited authority, and I am directed by their Lordships to acquaint you that the reasons which you have at present alleged appear to them to be insufficient to justify you in having continued to retain that gentleman's services without further express reference to this Board.

My Lords have not yet replied to the Comptroller and Auditor General as to the discharge of your account for these payments, and as the time is approaching at which the Estimates for 1873–4 have to be prepared, my Lords will be glad to receive also (as soon as possible) a statement of any fresh reasons you may wish to offer against the removal, after the end of the current financial year, of this charge from the votes in supply.

I am, &c.
(Signed) CHAS. W. STRONGE,
The Registrar General. pro Sec.

13,926.
SIR, September 21, 1872.

IN reply to your letter of 16th inst., I regret to own that inadvertently I have omitted to act upon the suggestion of the Lords Commissioners of Her Majesty's Treasury, conveyed to me in your letter of 7th February 1868.

I hasten to protest that I must not be considered guilty of anything so heinous as wilfully and designedly disobeying their Lordships instructions.

I did not, in written letters recorded in official ledgers at that time, communicate with the Royal Society, but from personal inquiries I satisfied myself that that learned body could not give the same particulars that I receive from the Royal Observatory at Greenwich, with the same regularity for immediate publication; and I am sorry to say I accidentally omitted to make that report to their Lordships. To me, personally, it was of course immaterial whether the particulars were furnished by the Royal Society or from the Royal Observatory at Greenwich.

I have now written to the Royal Society, and will inform their Lordships when I receive their reply.

I imagine that their Lordships do not wish to see the Meteorological Returns abridged, which for so many years I have been in the habit of publishing, the value of which was fully pointed out in my letter to you of 21st December 1864.

I have, &c.
(Signed) GEORGE GRAHAM,
To the Secretary, Treasury. Registrar General.

SIR, November 9, 1872.

I WILL thank you to inform the Lords Commissioners of Her Majesty's Treasury that, in accordance with the wish I understood to be expressed by their Lordships, I have asked the Royal Society whether they could furnish me with the information and Reports on Meteorological subjects now supplied to me weekly, quarterly, and yearly, by Mr. Glaisher of the Royal Observatory at Greenwich, seeing that 10,000*l*. per annum is received from the public by the Meteorological Committee of the Royal Society.

I have received a reply, a copy of which I now enclose, and I shall be glad to receive instructions from their Lordships as to any further steps they desire me to take in this matter.

I have, &c.
(Signed) GEORGE GRAHAM,
To the Secretary, Registrar General.
Treasury, Whitehall.

The Royal Society, Burlington House.
SIR, November 6, 1872.

IN reply to the inquiry contained in your letter of the 18th September 1872, I am directed by the President and Council of the Royal Society to explain that the weekly Meteorological Returns transmitted to your Office from the Royal Observatory, Greenwich, are supplied by the Astronomer Royal, and free of expense.

In case of any other information being desired from the Meteorological Committee, the President and Council suggest that application be made to the Board of Trade, under which Department the Committee acts.

I have, &c.
(Signed) W. SHARPEY, M.D.,
G. Graham, Esq., Secretary R.S.
Registrar General.

17,087. Treasury Chambers.
SIR, November 19, 1872.

I AM directed by the Lords Commissioners of Her Majesty's Treasury to acquaint you, for the information of the Lords of the Committee of Council for Trade, that for some years past an annual payment has been made through the Registrar General to Mr. Glaisher, one of the Assistants to the Astronomer Royal, on account of the preparation, by him, of certain tables of Meteorological Observations, which are published by the Registrar General with his Reports.

My Lords have received from the Registrar General a copy of a letter from the Royal Society (a copy of which is herewith enclosed), dated 6th November 1872, from which it appears that some misapprehension exists as to the terms on which these Returns are supplied, and bearing in mind the arrangement made in 1866, by which the sum of 10,000*l*. was placed on the Estimates in order to provide for Scientific Meteorological Observations, &c., to be undertaken by a Committee appointed by the Royal Society at the request of the Government, my Lords would be glad if their Lordships of the Committee of Council for Trade would cause a communication to be addressed to the Committee of the Royal Society with a view to ascertain whether the tables now furnished by Mr. Glaisher might not be supplied to the Registrar General by that Committee without incurring any charge beyond the 10,000*l*. a year they now receive.

I am to transmit copies of the Registrar General's Returns with Mr. Glaisher's tables appended.

I am, &c.
T. H. Farrer, Esq. (Signed) WM. LAW.

METEOROLOGY.

Board of Trade, Whitehall Gardens.
SIR, November 29, 1872.

I AM directed by the Board of Trade to acknowledge the receipt of your letter of the 19th instant (17,087) inquiring whether certain tables of Meteorological Observations, now furnished by Mr. Glaisher, might not be supplied to the Registrar General of Births, Deaths, and Marriages by the Meteorological Committee of the Royal Society, without incurring any charge beyond the 10,000*l*. a year they now receive.

Before taking the matter into further consideration, this Board would be glad if the Lords Commissioners of Her Majesty's Treasury would cause them to be informed specifically what particulars the Registrar General would require, also in what forms and at what periods these particulars would have to be furnished.

The Meteorological Committee have certain stations, observatories, telegraphic and others, from which they obtain reports, and it would be of importance to know whether the Registrar General would be satisfied with these, or if he thinks it necessary that reports should still be obtained from Mr. Glaisher's present stations, whether he can guarantee that the Committee would in future be able to obtain information from Mr. Glaisher's present stations.

Having regard to them, I am to suggest that it might be desirable that the Registrar General of Births, Deaths, and Marriages should be instructed to place himself in direct communication with the Meteorological Committee, who are ready to render all the help in their power.

I have, &c.
(Signed) W. R. MALCOLM.
The Secretary, Treasury.

18,248. Treasury Chambers.
SIR, December 7, 1872.

WITH reference to the correspondence which has taken place on the subject of the tables of Meteorological Observations supplied to you hitherto by Mr. Glaisher, one of the Assistants to the Astronomer Royal, for publication with your Reports, I am desired by the Lords Commissioners of Her Majesty's Treasury to transmit to you the enclosed copy of a letter which their Lordships have received from the Board of Trade on the subject, and I am to request that you will place yourself in communication with the Meteorological Committee of the Royal Society, in accordance with the suggestion contained in the last paragraph of that letter, and report the result to this Board.

I am, &c.
(Signed) WILLIAM LAW.
The Registrar General.

SIR, February 6, 1873.

I WILL thank you to lay before the Lords Commissioners of Her Majesty's Treasury the copies and extracts of a letter dated 7th January 1873, addressed to me by the Meteorological Committee of the Royal Society, and of a letter, dated 3rd February, which I have received from Mr. Glaisher, to whom I showed the first-named letter.

I think, beyond all doubt, the Committee would not be able to furnish with necessary regularity the observations for publication on specified days in the same fulness as they have for many years been received by me here without fail.

This would be so painful to Mr. Glaisher that, as their Lordships dislike giving him 150*l.* per annum, he offers to continue furnishing these Returns *gratuitously*.

I think their Lordships will hardly consent to such an arrangement proposed by this gentleman, so zealous in his calling.

I take the liberty of suggesting that their Lordships should recommend the Committee to give to Mr. Glaisher annually 150*l.* out of the immense sum placed every year at their disposal for like purposes.

I have, &c.
(Signed) GEORGE GRAHAM,
Registrar General.

To the Secretary,
Treasury, Whitehall.

Meteorological Office,
116, Victoria Street, London, S.W.
January 7, 1873.

SIR,

I AM instructed by the Meteorological Committee to inform you, in reply to your letter of the 17th ultimo, that having examined the list of stations from whence Meteorological Reports are printed in your various Returns, they are of opinion that there would be no difficulty in their supplying you with information of a similar character to that now published by you, without any additional charge to the Government beyond their annual grant.

Several private observers whose names appear in the Returns, already supply observations to this Office, and the Committee think it probable that a larger proportion of the remainder would do so if requested.

In order that you may be acquainted with the amount of information the Committee are now in a position to supply, I am instructed to send you the map herewith enclosed, on which I have marked in red the stations from which the Committee receive reliable daily observations. The number of these stations could be increased.

The Committee having a staff competent to discuss the Returns, would be most happy to meet the wishes of the Treasury by supplying such Returns free of charge.

I am instructed to point out to you, that they could not undertake to pay any sum of money out of the grant, with the management of which they are intrusted, for work to be carried on by any gentleman not under the entire control of, and in direct communication with the Committee.

I have, &c.
(Signed) ROBERT H. SCOTT,
Director.

G. Graham, Esq.,
Registrar General,
Somerset House, W.C.

MY DEAR SIR, Blackheath, February 3, 1873.

I THANK you for affording me an opportunity of perusing the correspondence that has taken place with reference to the meteorological matter supplied by me to you for publication in your Quarterly Reports, and for which in recent years I have received the sum of 150*l.* per annum.

I have supplied this information for the last 28 years, and in relation to the discussion that has occurred, I desire to place on record the history of the matter as far as I am concerned.

Previously to the year 1844, you published the results of a few observations, the accuracy of which you stated you had no means of determining, and you added that you had no one in your Office who could assist you in the reduction of the observations to useful and practical results.

I travelled at my own expense over the country, and induced 40 to 50 gentlemen of education to incur the expense of instruments, and to supply themselves with new ones where broken, also at their own expense, as well as to devote their time to taking the observations. Every attempt to collect a corps of observers previously had failed.

From the year 1844 I supplied the information to you adapted to your wants, at first without receiving any grant, then 50*l.* was granted, afterwards 100*l.*, and lately 150*l.* annually towards the expenses. It seems to be considered that 10,000*l.* paid for the Meteorological Office ought to cover all meteorological expenses, and in this I entirely agree. I go further and say that 10,000*l.* appears to me an extravagant sum to spend annually on Meteorology, even if it were properly devoted to the advance of the science. When the Royal Observatory at Greenwich, an institution that is charged with duties of a far higher scientific and national importance, and undertakes far more laborious work, is maintained at much less cost. I think advisedly and as an old meteorologist who has devoted more than 40 years of his life to the advance of the science, when I say that I can see no results that are obtained by the Meteorological Office that in any way represent the value of the money expended on them, and I am so clearly convinced of the inability of the Office to collect and properly reduce the information that it has been a pleasure to me to undertake and build up in accordance with the varied needs of your Office, and the advance of Science, for more than a quarter of a century, that rather than the work should be continued under the direction of others not competent to carry it on, I would willingly supply the matter to you, as for some years I did, free of expense.

The original foundation of the meteorological stations and the continued supply of observations I have received, together with the confidence and goodwill the observers have invariably shown towards me, have been a great source of pride to me, and I have never regarded the preparation of the matter I have forwarded to you for so many years in the light of work done for money.

I bore, as I have stated, the expense of the reduction of the observations, the labour and expense of correspondence, travelling expenses in visiting the stations, for a long time myself, and if necessary I am prepared to do so again.

The amount I received was devoted to paying expenses, and I have always considered, even in recent years when I have received 150*l.*, that my own services were given almost gratuitously.

With regard to the Meteorological Office supplying the information hitherto collected by myself, it could of course be done if the Office had as many stations with careful observers, as well scattered over the country as mine are, but in point of fact nothing of the kind is the case: the Office, at great cost, maintains six elaborate meteorological stations in England, Ireland, and Scotland, situated almost in a straight line (as near as possible), furnished with self-registering instruments, but placed differently in each. Now for the purpose for which the Meteorological matter is printed in your Returns, six stations would be useless, and the self-registration would give no additional value.

Mr. Scott, the Director of the Meteorogical Office, states that a good many observers who now forward reports to me would do so to that Office if requested, and it is not unlikely that a considerable number of the gentlemen who contribute information to me might, if asked to do so, send copies also to any Government Department; but setting aside the question of how far Mr. Scott, as the head of a Government Office, is morally justified in tampering with my corps of observers, the majority of whom were induced to take observations at my personal request, I do not believe any Government Department could afford to perform the work under a very considerable expense, and for this reason: I have been repeatedly asked by my observers whether I supplied the instruments, or whether any public body could supply them, and have invariably replied that I had no fund for such a purpose, and that they must bear the expenses themselves. Some would-be observers have then declined, but others I have induced to undertake the expense. Now I am certain that observers would not bear the cost of their own instruments; not to mention the devotion of their own time to supply information gratuitously to any Government office, particularly when that office had a very large sum of money at its disposal.

With regard to the great waste of public money, which I in common with most meteorologists, consider takes place by the Meteorological Office, I trust that if the Lords of the Treasury see fit to withhold the grant I have received, they may also consider whether it is not desirable that a considerable reduction may also be made in the amount annually devoted to Meteorology, which not only seems to me excessive, but likewise calculated to bring the science into disrepute, from the small return that is received for the money, due, as I consider, to its misappplication. I wish to except Sea Meteorology, the results from which I am of opinion are valuable, and for which *alone* the Office was founded.

I should not have felt called upon to express an opinion on the management of the Meteorological Office, only as its Director states that he can perform the work that I have hitherto done, I feel it due to myself to distinctly state why I desire the work begun by me, and continued during a great part of my life, should not be handed over to those in whom I could place no confidence, and, so long as I am able, I desire to continue, with or without a grant, the series of reports of which I was the founder, and in which I have reason to know every member of the medical profession places confidence.

I have not entered into more detail with regard to my objection to entrust work to the Meteorological Office, though I am ready to do so if required.

But I cannot close without expressing my opinion that no head of a Meteorological Office will inspire confidence who is not an observer himself, and contrasting the amount of information I have collected and afforded, for a sum never exceeding 150*l.*, with the work performed by the Office for a grant of 10,000*l.*

I am, &c.
(Signed) JAMES GLAISHER.
The Registrar General.

2200.
Treasury Chambers,
April 2, 1873.
SIR,

THE Lords Commissioners of Her Majesty's Treasury have had before them your letter of the 6th ultimo [February], and its enclosures, with respect to the supply to you by Mr. Glaisher, of the Royal Observatory, of Meteorological matter for the purpose of printing with your Reports.

I am to acquaint you that their Lordships are pleased to sanction the employment of Mr. Glaisher up to the present time at the salary, viz., 150*l.* per annum, but this sanction is limited to the year ending 31st March 1874.

A copy of this letter has been sent to the Comptroller and Auditor General with reference to his letter of the 30th August last, calling their Lordships' attention to Mr. Glaisher's continued employment, copy of which was sent you with the letter of this Board of the 14th [16] September last.

I am, &c.
(Signed) WILLIAM LAW.
The Registrar General.

APPENDIX III.

THE METEOROLOGICAL OFFICE.

COMMUNICATION from the DIRECTOR.

Royal Commission on Scientific Instruction
and the Advancement of Science,
6, Old Palace Yard, S.W.,
Feby. 27, 1875.
SIR,

WITH reference to your letter to Professor Smith, proposing to give further Evidence respecting additional work carried on by the Meteorological Office, I am directed by His Grace, the Chairman of this Commission, to say that any further information which you wish to place before the Commissioners may be conveyed in the form of a written communication.

I have, &c.,
J. NORMAN LOCKYER,
R. H. Scott, Esq., F.R.S. Secretary.

Meteorological Office,
116, Victoria Street, London, S.W.,
27 February 1875.
SIR,

I HAVE the honour to acknowledge the receipt of your letter of this day, and to inform you, in reply, that I shall submit a brief statement to you, in accordance with the kind permission of His Grace the Chairman of the Commission.

This statement will not have reference so much to "additional work carried on at the Meteorological Office," as to the action of the Permanent Committee of the Vienna Congress in the development of uniformity of operations in the different European countries.

I have, &c.,
ROBERT H. SCOTT,
Director.

Norman Lockyer, Esq., F.R.S., Secretary,
Royal Commission on Scientific
Instruction, &c.

Meteorological Office,
116, Victoria Street, London, S.W.,
March 11, 1875.
SIR,

IN accordance with the kind permission from His Grace the Chairman of the Science Commission, conveyed to me in your letter of the 27th ult., I beg to enclose a memorandum containing some evidence supplementary to that already tendered by me to the Commission.

I have the honour to be
Your obedient servant,
ROBERT H. SCOTT,
J. N. Lockyer, Esq., F.R.S. Director.

SUPPLEMENTARY EVIDENCE for the ROYAL COMMISSION on SCIENTIFIC INSTRUCTION and the ADVANCEMENT OF SCIENCE.

Qu. 13,925. Arrangements have been concluded between the Meteorological Society and the Meteorological Office, and have come into effect on the 1st January 1875. The principal features of these arrangements are that the Observers belonging to these two organizations are supplied with an uniform schedule for recording their observations, and that the Society undertakes to furnish to the Office monthly returns from certain selected stations for publication with the returns from its own stations, in consideration of a certain payment, which will probably average about 50*l.* per annum.

An invitation has been issued to the Scottish Meteorological Society to co-operate with the Office on similar terms, and the Meteorological Committee are not without some hope that this proposal may be accepted.

Qu. 13,933. The Trinity House and the Commissioners of Irish Lights have undertaken to have observations of sea temperature taken at certain lightships and at one lighthouse. The Commissioners of Northern Lights have declined to co-operate on the ground of having no lightships.

The Committee have been requested by the "Commission Zur Wissenschaftlichen Untersuchung der Deutschen Meere" to organize a series of observations on the Western Coasts of the North Sea, similar to that organized under its own auspices on the German shores.

The Committee have not felt themselves in a position to undertake so complete an investigation, as much of the enquiry would be of a biological character, and, therefore, foreign to their own sphere of operations.

Qu. 13,939. In virtue of the arrangements mentioned under Qu. 13,925, the Office is prepared, if necessary, to supply returns of trustworthy character from January 1st, 1875, from at least 36 stations distributed over Great Britain and Ireland, and there is no doubt that this list could be largely increased to meet the requirements of the Registrar-General, if such stations as the Royal Observatory, Greenwich, the Radcliffe Observatory, Oxford, the Bidston Observatory, Birkenhead, were requested to continue to send to the Meteorological Office their returns as soon as the Registrar-General ceased to receive them directly.

Qu. 13,961. The Permanent Committee of the Vienna Congress held a meeting at Utrecht this year, and adopted certain measures tending towards the attainment of greater uniformity in climatological enquiry than has hitherto obtained.

The chief of these measures has been the recommendation that at a certain number of stations in each country observations of a similar nature should be taken and should be published on an uniform system, so as to be capable of being bound up together. These observations are to be published in full, and a form has also been devised for the publication of yearly *résumés* from all stations.

The number of stations suggested for each country is as follows:—

Norway - - - - -	10
Sweden - - - - -	10
Denmark, with Iceland and Färoe - -	6
Great Britain and Ireland - - -	15
Russia in Europe - - - -	50
Russia in Asia - - - -	100
Netherlands - - - -	2
Belgium - - - - -	2
Germany - - - - -	12
France - - - - -	12
Austria and Hungary - - -	15
Turkey - - - - -	10
Switzerland - - - - -	5
Italy - - - - - -	12
Spain, Portugal (and Azores) - -	12
Greece - - - - -	3

The Permanent Committee have reason to hope that this proposal will be accepted by *all* the nations of Europe with one or two exceptions, among which France should be mentioned, inasmuch as she was not represented at the Congress of Vienna.

Qu. 13,962. I have been elected Secretary to the Permanent Committee.

Qu. 14,402. The Maritime Conference mentioned was held in September 1874 at the Meteorological Office. It was of a private, *i.e.* non-official, character, and was attended by the following gentlemen:—

Austria	R. Müller	Director of the Imperial Royal Hydrographic Office at Pola.
Belgium	F. van Rysselberghe	Navigation School, Ostend.
Bengal	H. F. Blanford	Secretary Meteorological Committee, Calcutta.
China	J. D. Campbell	Inspectorate General of Chinese Maritime Customs, London.
Denmark	Capt. N. Hoffmeyer	Director of the Royal Danish Meteorological Institute, Copenhagen.
France	A. Delamarche	Ingénieur Hydrographe, Ministry of Marine, Paris.
„	C. Sainte Claire Deville	Inspector of French Meteorological Stations, Paris.
Germany	W. H. v. Freeden	Director of the "Deutsche Seewarte" at Hamburg.
„	H. A. Meyer	Commissioner for Investigating the German Seas, Kiel.
„	G. Neumayer	Hydrographer, Berlin.
„	Capt. Stempel	Imperial Navy.
Great Britain	R. J. Mann, M.D.	President of the Meteorological Society, London.
„	Rear-Adm. M. F. Nolloth	Representative of the Admiralty.
„	R. H. Scott, F.R.S.	Director of the Meteorological Office, London. Hon. Secretary to the Sub-Committee.
„	Capt. H. Toynbee	Marine Superintendent, Meteorological Office. (Representative of the Board of Trade.)
Holland	H. Buys Ballot	Director of the Royal Meteorological Institute of the Netherlands, Utrecht.
„	Lieut. J. E. Cornclissen	Marine Superintendent, Utrecht (Royal Dutch Navy).
Italy	Capt. N. Canevaro	Naval Attaché to the Royal Italian Legation, London (Royal Italian Navy).
Norway	H. Mohn	Director of the Royal Norwegian Meteorological Institute at Christiania.
Portugal	J. C. de Brito Capello	Director of Nautical and Meteorological Observations, Observatory of the Polytechnic School, Lisbon.
Russia	A. Moritz	Director of the Observatory at Tiflis.
„	Capt. M. Rikatcheff	Central Physical Observatory, St. Petersburg (Imperial Navy).
Spain	Capt. H. Montojo	Spanish Navy.
„	Capt. C. Pujazon	Director of the Marine Observatory, San Fernando (Spanish Navy).

Every nation in Europe, except Greece, Sweden, and Turkey, was represented. The United States, however, took no part in the Conference.

The Report of the Conference has now appeared, and contains the replies from the various nations respecting the working of the Brussels Conference referred to by me under Qu. 14,401.

The result of the deliberations was to approve, on the whole, of the Brussels Resolutions, and to recommend for general adoption a plan of observation and record almost identical with that in use in our own Office.

Qu. 14,432. The Permanent Committee have supported the request for copies of the Hourly Tabulations from our automatic records, and the Committee have undertaken to issue them for the year 1875 as well as for 1874, but the subscribers have been extremely few.

ROBERT H. SCOTT.

APPENDIX IV.

RESOLUTIONS passed at the LAST MEETING of the COMMISSION.

[Extracted from the Minutes.]

"At this, the final meeting of the Royal Commission on Scientific Instruction and the Advancement of Science, the following Resolutions were carried unanimously:

"I. That the Commissioners desire, before separating, to place on record their high sense of the value of Mr. J. Norman Lockyer's services as Secretary to the Commission.

"The labours of the Commission have extended over a period of more than five years, during which Mr. Lockyer has been constantly engaged in procuring and arranging for the Commissioners information upon various and important subjects connected with Science.

"The Commissioners would refer more especially to Mr. Lockyer's exertions as Assistant-Commissioner for enquiring into Scientific Teaching in Public Schools.

"The Commissioners consider that they have been very fortunate in obtaining the services of a Secretary who combined eminence in scientific enquiry with experience of the business of the Public Departments.

"The Commissioners desire, in conclusion, to express a hope that, on the termination of the Commission, some arrangement may be made by which the services of Mr. Lockyer, in the promotion of Science, may be secured to the country.

"II. That the above Resolution be printed in the Appendix, and that His Grace the Chairman of the Commission be requested to lay it before the Prime Minister and the Lord President of the Council."

ANALYSES

OF THE

EVIDENCE CONTAINED IN THIS VOLUME.

ANALYSES OF THE EVIDENCE

RESPECTING

METEOROLOGY.

SCOTT, ROBERT H., Esq., M.A., F.R.S. (Index of his Evidence.)

Accommodation for Science Purposes.
Meteorological Office is not located in a public building; it utilizes existing buildings for observational purposes, 13,886, 14,011–14,014, 14,393–14,398, 14,483.

Admiralty.
Meteorological Office is constantly consulted by Admiralty Court, 13,948.

Army Medical Department.
Army Medical Department is being organized in conjunction with Meteorological Office, 13,950.

Austria.
Meteorological Congress at Vienna; permanent committee appointed, 13,958–13,963.
Allowance in Austria for meteorological observations, 14,020 (App. B.)

Board of Trade.
Meteorological Office was originally under Board of Trade; it should be so again, 13,861–13,874, 13,904, 13,978.

British Association.
Grants given by British Association for rainfall observations, 13,940–13,947.

Brussels.
Brussels Conference proposed a uniform system for ocean observations; English only adhere to it, 14,400, 14,401.

Colonies.
Meteorological organizations exist in India, New South Wales, New Zealand, &c., 13,952–13,955.

France.
French Meteorological Department; no proper organization; connexion with London Meteorological Office, 13,957, 14,449, 14,454–14,456.

FitzRoy, Admiral.
Admiral FitzRoy; formerly head of Meteorological Department; his publication of fragmentary notices; his signals still used, 13,863, 13,864, 13,906, 13,932, 14,386, 14,387, 14,420, 14,454, 14,458, 14,465, 14,467.

Government.
Relation of Government to Meteorological Office; disclaims connexion; gives an annual vote, 13,861–13,874, 13,904–13,906.

Grants for Science Purposes. See *Income and Expenditure.*

Greenwich.
Correspondence with Astronomer Royal respecting Greenwich Observatory as a centre for meteorological purposes, 13,912–13,915.

Income and Expenditure.
Meteorological Office; its Government vote of 10,000*l.* a year; serious want of funds; payments to observers; smallness of salaries, &c., 13,871, 13,872, 13,890–13,895, 13,900–13,902, 13,918, 13,932, 13,964–14,019, 14,438–14,447, 14,490–14,493.
Scottish Meteorological Society's proposal for a grant not acceded to, 13,929–13,932.

Kew.
Kew Observatory the central one for Meteorological Office; scientific instruments are verified there, 13,907–13,915, 14,388, 14,424–14,426, 14,483–14,487.

Merchant Service.
Meteorological Office lends instruments to captains in merchant service, and receives observations, 13,896–13,903.

SCOTT, ROBERT H., Esq.—cont.

Meteorological Office (London).
Meteorological Office; its history, organization, staff, anomalous position, want of funds, &c., 13,861–14,020, 14,381–14,496.

Meteorological Offices (Foreign).
London Meteorological Office has relations with foreign offices; these have smaller grants than England, 13,956–13,958, 13,968, 13,969, 14,020 (App.)

Meteorological Society (London).
Meteorological Office would accept proposed co-operation of Meteorological Society if funds were sufficient, 13,925–13,928.

Meteorological Society (Scotland). See *Scottish Meteorological Society.*

Meteorology.
Meteorological observations; an experimental observatory is much wanted, 13,861–14,020, 14,381–14,496.
Importance of centralization for meteorological observations, 13,951.
Metric system not desirable for meteorological observations 13,963.

Metric System.
Objection to adoption of metric system for meteorological observations, 13,963.

Observatories.
Meteorological Office has seven observatories; continuous records taken photographically, and mechanically in case of winds, 13,907–13,915, 13,995, 14,423–14,426, 14,483–14,489.
Serious want of an experimental observatory for meteorology; it should deal with nothing but mean results, 14,483–14,489.

Rainfall.
Meteorological Office should determine rainfall for general, not local, meteorological purposes, 13,940–13,947.
British rainfall organization is private; originated with Mr. Symons, aided by British Association, &c., 13,940–13,947.

Registrar-General.
Registrar-General's returns; Meteorological Office desirous not to publish similar information, 13,934–13,939, 14,020 (App. A.)

Royal Navy.
Meteorological Office supplies Royal Navy with instruments, and receives observations, 13,891–13,903, 14,490.

Royal Society.
Royal Society's connexion with Meteorological Office; has no control, but nominates committee of management, 13,864–14,020.

Russia.
Allowance in Russia for meteorological observations, 14,020 (App. B.)

Science.
Importance to Meteorological Office of having scientific supervision, 13,873.

Scientific Instruments.
Meteorological Office furnishes Royal Navy, merchant service, agents at ports, &c. with recording instruments, 13,891—13,903, 14,381–14,393, 14,399–14,422, 14,428–14,430, 14,471, 14,476–14,478.
Use of Galton's pantagraph, Amsler's planimeter, and De la Rue's anemometers with bells, by Meteorological Office, 14,427–14,430, 14,471.

Scott, Robert, H., Esq.—cont.

Scientific Publications—*cont.*
- Charts of ocean currents, surface temperature, &c. issued by Meteorological Office; difficult to prepare charts of large areas; 530 reports issued daily, 14,408–14,418, 14,457, 14,479, 14,480.
- Continuance of "Fragmentary Papers" by Meteorological Office desirable, 14,419–14,422.
- "Atlas des Mouvements généraux de l'Atmosphère," formerly published in France; now suspended, 14,454.

Scotland.
- Expenses of meteorological establishments in Scotland, 13,932.

Scottish Meteorological Society.
- Meteorological Office desired to co-operate with Scottish Meteorological Society; failure of negociations, 13,929–13,932.

Sundays.
- Meteorological Office does not receive or issue reports on Sundays, 14,469.

Telegraphy.
- Meteorological Office telegraph system; 29 stations for morning reports, 7 for afternoon; freer use of telegraphs desirable, 13,917–13,921, 13,998–14,003 14,441–14,448, 14,471–14,475, 14,494, 14,495.
- United States telegraphs are stopped at certain times for transmission of meteorological reports, 14,444.
- Foreign systems of telegraphy are various, but uniformity is hoped for, 14,475.

United States.
- Great scale of Meteorological Department in United States; system of synchronous observations established with England, 14,444–14,447, 14,450, 14,470.

STEWART, BALFOUR, Esq., LL.D., F.R.S. (Index of his Evidence.)

Board of Trade.
- When under Board of Trade, as now, Meteorological Office observations related to physical meteorology, 14,067–14,072.

British Association.
- Great value of rainfall observations carried on by British Association, 14,059, 14,060.

Committees.
- Objection to unpaid committees like Meteorological Committee, 14,061.

Electricity.
- No records of atmospheric electricity except at Greenwich and Oxford; Meteorological Office will probably commence observations soon, 14,021, 14,051, 14,097.
- Observations on atmospheric electricity should be taken by meteorological observatories generally, 14,055, 14,056.

FitzRoy, Admiral.
- Admiral FitzRoy's observations related to physical meteorology, 14,068, 14,072.

Glaisher, Mr.
- Valuable meteorological work done by Mr. Glaisher; distinct from that of Meteorological Office, 14,075–14,090.

Government.
- Physical meteorology is a proper subject for Government support; climatic meteorology might have some aid, 14,031–14,047, 14,051, 14,057, 14,067–14,101.
- Special meteorological expeditions should be undertaken by Government, 14,048, 14,049.

Grants for Science Purposes.
- Government grant for climatic meteorology should be given through scientific societies, 14,047, 14,052.

Greenwich.
- Photographic observations of the sun's disc are regularly taken at Greenwich, 14,023.
- Observations on atmospheric electricity are taken only at Greenwich and Oxford, 14,021, 14,051, 14,097.

Meteorological Committee.
- Objections to Meteorological Committee; a Meteorologist Royal should be appointed, 14,035, 14,036, 14,061, 14,102–14,109.

Meteorological Office (London).
- Meteorological Office; objection to its committee of management; general approval of its work, 14,021–14,114.

Meteorological Offices (Foreign).
- Foreign Government Meteorological Departments are chiefly for physical meteorology, 14,091, 14,092.

Stewart, Balfour, Esq.—cont.

Meteorological Society (England).
- Meteorological Society might be employed to render aid in regard to climatic meteorology, 14,053.

Meteorologist Royal.
- Desirable that a Meteorologist Royal, responsible to Government, should be appointed, 14,035, 14,036, 14,061, 14,102–14,109.

Meteorology.
- Meteorological science; recent advances, &c., 14,021–14,023.
- Meteorology, physical and climatic; former should be aided by Government, 14,031–14,047, 14,057, 14,067–14,101.
- Government should undertake special expeditions for meteorological purposes, 14,048, 14,049.
- Meteorological observations should be taken at a number of stations, which should be visited and inspected, 14,062–14,066.

Observatories.
- Solar observations require a special observatory; it need not be costly, 14,024–14,030.
- Observations on atmospheric electricity might be undertaken by meteorological observatories generally, 14,055, 14,056.

Ocean.
- Oceanic meteorology; knowledge imperfect; Government expeditions desirable, 14,048, 14,049, 14,111, 14,112.

Oxford.
- No records of atmospheric electricity except at Oxford and Greenwich, 14,021, 14,051, 14,097.

Photography.
- Photographic observations of the sun's disc are taken at Greenwich; will probably be undertaken in India, Mauritius, &c., 14,023.

Rainfall.
- Rainfall observations are of great value; better carried on voluntarily than by Meteorological Office, 14,059, 14,060.

Registrar-General.
- Meteorological Office should not have to furnish observations to Registrar-General's Department, 14,038–14,044, 14,075–14,090, 14,098–14,101.

Royal Society.
- Royal Society's Meteorological Committee might be dispensed with, 14,035, 14,036, 14,061, 14,102–14,109.

Science.
- Progress of meteorological science, 14,021–14,114.

Scientific Instruments.
- Use of self-recording instruments in Meteorological Office, 14,021, 14,022.

Scientific Societies.
- If Government aid be given to climatic meteorology, it should be through scientific societies, 14,046, 14,052.

Scottish Meteorological Society.
- Scottish Meteorological Society is doing great good; encouragement desirable, 14,046, 14,052, 14,058.

Sun.
- Photographic observations of the sun are taken at Greenwich, &c., 14,023.
- Special observatory desirable for solar observations, 14,024–14,030, 14,055, 14,113, 14,114.

Telegraphy.
- Weather telegraphy should continue to be taken by Meteorological Office, 14,041.

MAIN, The Rev. ROBERT, M.A., F.R.S. (Index of his Evidence.)

Colonies.
- Photographic meteorological observations are carried on at Toronto, 14,161.

Denmark.
- English Government should co-operate with Denmark for meteorological purposes, 14,148, 14,149.

Glaisher, Mr.
- Value of Mr. Glaisher's work; to stop it would increase expense without gain to science, 14,173–14,197.

Government.
- Government should promote international meteorology, 14,130–14,140, 14,147, 14,169, 14,170.

MAIN, Rev. ROBERT—cont.

Greenwich.
Meteorological observations are taken at Greenwich; they will be very valuable, 14,123, 14,158, 14,159.
Greenwich Observatory does all that is necessary for solar physical observations, 14,152.

Income and Expenditure.
Expenses of meteorological observatories, 14,198–14,209.

Meteorological Committee.
Meteorological observations at Oxford are independent of Meteorological Committee, 14,118, 14,119.
Approval of work carried on under direction of Meteorological Committee, 14,129, 14,139–14,143.

Meteorological Office.
Meteorological Office; approval of system; it should not include Registrar-General's observations, 14,118, 14,129–14,143, 14,173, 14,179.

Meteorological Society.
Principal value of Meteorological Society is in publishing records by private observers, 14,155–14,157.

Meteorology.
Meteorological science at Oxford, &c., 14,115–14,210.
Meteorological observations are wanted from Greenland, Iceland, &c., 14,117, 14,144, 14,170, 14,171.
Meteorological observations are best carried on at astronomical observatories, 14,120.
Great want of international meteorology, 14,129–14,138, 14,169.
Climatic meteorology may be left to individuals, 14,153.
Photographic meteorological observations should be made at all important astronomical observatories, and reduced on same plan, 14,160–14,169.

Norway.
Important meteorological work done in Norway, 14,117, 14,144–14,146.

Observatories.
At Radcliffe Observatory meteorological observations have been taken since 1811, 14,115–14,122.
Astronomical observatories are the best places for carrying on meteorological work; they should undertake photographic observations, 14,120, 14,160–14,169.
Good physical observatory at St. Petersburg, 14,124.

Oxford.
Meteorological observations at Oxford; taken from 1811, 14,115–14,128.

Photography.
At Radcliffe Observatory photographic meteorological observations have been taken since 1854, 14,115–14,122.
Photographic meteorological observations should be carried on at every important astronomical observatory, 14,160–14,163.

Registrar-General.
Registrar-General's observations need not at present be transferred to Meteorological Office, 14,173–14,197.

Russia.
Important central physical laboratory for Russia at St. Petersburg, 14,124.

Scientific Publications.
Approval of synoptic charts published by Meteorological Committee, 14,129, 14,139.
Valuable work of private observers published by Meteorological Society, 14,155–14,157.

Scientific Societies.
Great value of scientific societies as a medium for publishing observations, 14,155–14,157.

Scottish Meteorological Society.
Good work done by Scottish Meteorological Society, 14,154.

Sun.
What is done at Greenwich with regard to solar physical observations is sufficient, 14,152.

Sweden.
Co-operation with Sweden for meteorological purposes desirable, 14,147.

STRACHEY, MAJOR-GENERAL RICHARD, R.E., F.R.S
(Index of his Evidence.)

Board of Trade.
Connexion of Meteorological Committee and Board of Trade; it relieved Board of Trade of a function specially scientific, 14,213–14,220, 14,254, 14,262.

Director.
Director for meteorology may become essential; difficult to find the proper person, 14,226, 14,291, 14,292.

STRACHEY, Major-General—cont.

Glaisher, Mr. See *Registrar-General.*

Government.
Meteorology a proper subject for Government aid; more should be given, 14,223–14,226.

Income and Expenditure.
Meteorological Committee could not do more with present funds; these are regulated by Board of Trade, 14,217–14,222, 14,229–14,230.

India.
Meteorological work should be extended in India; it is of vast practical importance in relation to drought and famines, 14,228, 14,298–14,301.

Meteorological Committee.
Meteorological Committee undertakes ocean and land observations, weather warnings, publication of reports, &c., 14,211–14,301.
Meteorological Committee is a quasi-financial body, with scientific knowledge, 14,285–14,288.
Approval of work done by Meteorological Committee; it should not direct scientific research, 14,286–14,288.
With a greatly extended system, a Government department should replace Meteorological Committee, 14,226, 14,289.

Meteorological Society (London).
No relation between Meteorological Committee and Meteorological Society, 14,264–14,268.

Meteorology.
Meteorology in England; more State aid required; a public department and director might become requisite, 14,211–14,297.
Meteorological science better provided for in America, &c, than in England, 14,227.
Meteorological observations are more easily made in tropical countries, 14,228.
Climatic meteorology; observations need be made only at a few points, and great expenditure would be undesirable, 14,269–14,284.
To extend meteorological science, Government and the public should declare extension desirable, 14,293, 14,294.
Scientific part of meteorology is in want of cultivation, 14,295.

Navy.
Meteorological Committee supplies instruments to ships, 14,212.

Observatories.
Seven observatories under direction of Meteorological Committee, 14,212.

Original Research.
Original research not undertaken by Meteorological Committee; better done by private individuals, 14,217, 14,287, 14,288, 14,290.

Registrar-General.
Offer of Meteorological Office to supply Registrar-General with information like that furnished by Mr. Glaisher, 14,233–14,246, 14,259, 14,260.

Royal Society.
Royal Society not responsible for acts of Meteorological Committee, 14,214.

Scientific Instruments.
Meteorological Committee supplies instruments to ships, 14,212.

Scientific Publications.
Monthly and quarterly reports, with diagrams, issued by Meteorological Committee, 14,212.

Scottish Meteorological Society.
Scottish Meteorological Society were refused a grant by Meteorological Committee, 14,261–14,264.

United States.
Liberal provision for meteorology in United States, 14,227.

BUCHAN, ALEXANDER, Esq. (Index of his Evidence.)

America.
International meteorology proposed by American Government, 14,319.

Fisheries.
Inquiry by Scottish Meteorological Society and Fishery Board in regard to meteorology as affecting fisheries, 14,303.

Government.
Government Meteorological Department, with paid council, desirable, 14,365–14,371.

BUCHAN, ALEXANDER, Esq.—cont.

Income and Expenditure.
- The 10,000*l.* granted to Meteorological Office might, for meteorological purposes, be better employed, 14,336.

Meteorological Committee.
- Work of Meteorological Committee; barometric observations valuable; bad position of instruments; should be confined to physical meteorology, 14,327–14,350, 14,373.

Meteorology.
- Important work performed by Scottish Meteorological Society, 14,302–14,380.
- Scheme of international meteorology proposed by American Government, 14,319.
- Physical and climatic meteorology should be divided; large observatories taking the former, societies the latter, 14,323–14,326, 14,341.
- Maritime meteorology might have a distinct office, jointly under Board of Trade and Admiralty, 14,341–14,350.
- Inspection requisite at all meteorological stations, 14,351–14,364.
- Government department for meteorology desirable; it should have a paid committee, and be responsible to a Minister or Board of Trade, 14,365–14,371.

Navy.
- The Navy should be more utilized for meteorological purposes, 14,343–14,350.

Observatories.
- Necessity for a central observatory for physical meteorology; it should have a scientific head, and State funds, 14,323–14,326.

Registrar-General.
- Returns of Registrar-General and Mr. Glaisher are singularly accurate, 14,319.

Registrar-General (*Scotland*).
- Scottish Meteorological Society supplies Registrar-General for Scotland with observations similar to those of Mr. Glaisher, 14,320–14,323.

Scientific Instruments.
- Physical observatories should supply scientific societies with instruments, 14,326.
- Objection to position of instruments used by Meteorological Office, 14,331–14,335.

Scientific Societies.
- Meteorology, in relation to health, agriculture, &c., should be undertaken by scientific societies, 14,323–14,326, 14,341.

Scotland.
- Necessity for more meteorological stations in Scotland than in England, 14,377.

Scottish Meteorological Society.
- Work of Scottish Meteorological Society regarding fisheries, storm stations, human mortality, agriculture, &c., 14,302–14,380.
- Stations of Scottish Meteorological Society; some are in Iceland, Jerusalem, Damascus, Brazil, &c., 14,326, 14,373–14,380.

BUCHAN, ALEXANDER, Esq.—cont.

Telegraphy.
- Objection to returns from telegraphic stations of Meteorological Office, 14,334, 14,360.

[See also the Analysis of the Evidence previously given, in the Appendix to vol. II., p. *204*.]

GLAISHER, JAMES, Esq., F.R.S. (Index of his Evidence.)

Government.
- Government should undertake the physical meteorology of the globe, 14,518–14,526, 14,549–14,553.
- Objection to scientific societies or private observers receiving State aid, 14,520–14,523.

Greenwich.
- Greenwich observations; 20 years photographic observations now being reduced; returns sent to Registrar-General, 14,500, 14,525, 14,545–14,547.

Income and Expenditure.
- Mr. Glaisher now receives 150*l.* a year for his observations; he formerly made them gratuitously, 14,509.

Meteorological Office.
- Meteorological Office work and Mr. Glaisher's, 14,497–14,553.
- Difficult for Meteorological Office to furnish Registrar-General's returns; present system should be continued, 14,515–14,521, 14,533–14,538.
- Meteorological Office should confine itself to sea operations, 14,518–14,529.

Meteorology.
- Mr. Glaisher's meteorological observations have been made for 30 years; 50 or 60 observers have aided him, 14,497–14,553.
- Sea meteorology must be aided by the State; land meteorology may be left to private observers, 14,518–14,526.

Registrar-General.
- Registrar-General's meteorological returns; supplied by Mr. Glaisher and voluntary observers for 30 years, 14,497–14,553.
- Objection to Meteorological Office supplying observations for Registrar-General, 14,515–14,521, 14,533–14,538.

Ocean.
- Importance of sea meteorology; system should be extended, 14,518–14,526, 14,549–14,553.

Photography.
- Volunteer observers could not undertake photographic observations, 14,530, 14,531.
- Photographic meteorological observations are desirable at a few stations only; their permanence is not important, 14,532–14,532, 14,539.

Scientific Instruments.
- Defective meteorological instruments formerly in use; improved by Mr. Glaisher's means, 14,500, 14,517.
- Objection to position of instruments used by Meteorological Office, 14,515, 14,516.

Scientific Societies.
- Scientific societies should never receive Government aid, 14,520–14,523.

INDEX

TO THE

REPORTS ISSUED BY THE COMMISSION (WITH THEIR APPENDICES).

A.

Aberdeen University.
Study of science, students, degrees, &c. at, *Rep*. VII., p. 4, 27; *App*. p. 72, 73.
Salaries in, estimates for, &c., *Rep*. VII. *App*., p. 45.

"Abiturienten Examen."
In Germany; approval of, *Rep*. III., p. ix.

Accommodation for Science Purposes.
Buildings for classes under Department, *Rep*. II., p. xxii.
Universities should be ready to increase their buildings for science, *Rep*. III., p. xxx.
See ROYAL SCHOOL OF MINES, &c.

Acland, Dr.
On Museum of Oxford, *Rep*. III., p. xxxviii.
On science teaching in schools, *Rep*. VI. *App*., p. 75.

Adams, Professor J. C.
On classical and scientific study in universities, *Rep*. III., p. x.

Adams, Professor W. G.
On King's College applied science department, *Rep*. V., p. 9.

Admiralty.
In relation to proposed council of science, *Rep*. VIII., p. 31.

Ages of Science Students.
Under Science and Art Department, *Rep*. II., p. xxiv.
At Owens College, *Rep*. V., p. 18.
In public schools, *Rep*. VI., p. 6–10.

Agricultural Museum, Dublin.
Supported by Royal Dublin Society, *Rep*. IV., p. 15.

Agriculture.
Chairs of, in Edinburgh University and Queen's College, Belfast, *Rep*. VII., p. 5, 38.

Airy, Sir George.
On physical astronomy being taken up by Government, *Rep*. VIII., p. 13.
On extension of Greenwich Observatory for astronomical physics, *Rep*. VIII., p. 15.
Objection of, to a minister of science, and paid consultative council, *Rep*. VIII., p. 29, 41.

Anatomy.
Chair of, should be separate from physiology, *Rep*. III., p. xxvi.

Anderson, Mr.
On want of investigations relating to iron, machinery, &c., *Rep*. VIII., p. 4.
On advantage of a small council of science, *Rep*. VIII., p. 38.

Andersonian Institution, Glasgow.
Foundation, faculties, fees, &c. at, *Rep*. VII., p. 21.

Apparatus for Science Purposes.
For classes under Science and Art Department, *Rep*. II., p. xxii.
Universities should supply, *Rep*. III., p. lix.
Want of a museum of, at South Kensington, *Rep*. IV., p. 13.
In endowed schools, *Rep*. VI., p. 1, 5; *App*. 57, 58, 183.
Catalogue of, for physics and chemistry, *Rep*. VI. *App*., p. 77.
See EDINBURGH UNIVERSITY.

Applied Science.
Department of, at King's College, *Rep*. V., p. 8, 9.

Appointment of Professors.
At Oxford and Cambridge, *Rep*. III., p. xxxi.
At Catholic University of Ireland, *Rep*. V., p. 25.

Appointments to Fellowships.
At Oxford and Cambridge, *Rep*. III., p. xlix.

Armstrong, Sir William.
On Newcastle College of Science, *Rep*. V., p. 22, 23.

Army.
Experimental researches made for the, *Rep*. VIII., p. 2.

Artizans.
Lectures for, at Museum of Practical Geology, *Rep*. I., p. vii.
Importance to, of museums of scientific apparatus, *Rep*. IV., p. 13.
Demonstrations for, in British Museum, *Rep*. IV., p. 18.
Scientific lectures proposed for, *Rep*. IV., p. 21.
Lectures for, at Owens College, *Rep*. V., p. 18; *Rep*. VII., p. 21, 25.

Assistant Professors, Demonstrators, &c.
See OXFORD UNIVERSITY, &c.

Astronomical Physics.
Promotion of, at Oxford, *Rep*. III. *App*., p. lxiii.
Remarks on evidence relating to, *Rep*. VIII., p. 25.

Astronomy.
University prizes for, *Rep*. III., p. xiv.
Two professorships desirable for, at Cambridge, *Rep*. III., p. xxviii.
Observations in, conducted under Government, *Rep*. VIII., p. 1.
Estimates for, in 1874–5, *Rep*. VIII. *App*., p. 49.
See GREENWICH OBSERVATORY, OBSERVATORIES, &c.

B.

Ball, Mr. J.
On the national botanical collections, *Rep*. IV. *App*., p. 28.
On professors' salaries at Cooper's Hill College, *Rep*. V. *App*., p. 38.
On necessity for a minister of science, *Rep*. VIII., p. 28.

Banksian Library.
Must be kept with the Banksian collections of the British Museum, *Rep*. IV., p. 4.

Bell, Mr. I. Lowthian.
On Newcastle College of Science, *Rep*. V. p. 22–24.

Bentham, Mr.
On the national botanical collections, *Rep*. IV. *App*., p. 28.

Berkeley, Rev. M. J., and others.
Memorial from, on the national herbaria, *Rep*. IV. *App*., p. 31.

Berlin University.
Science in, as compared with Oxford and Cambridge, *Rep*. III., p. xxii.

Biology.
University scholarship wanted for, *Rep*. III., p. xiv.
At Oxford University; chair proposed, *Rep*. III., p. xxvii.; *App*., p. lxi.
At Cambridge; more professorships desirable, *Rep*. III., p. xxviii.

Birkbeck Chemical Laboratory.
At University College, *Rep*. V., p. 6.

Board of Longitude.
Reference to services of, *Rep*. VIII., p. 41, 45.

Board of Trade.
Mining Record Office proposed to be placed under, *Rep*. I., p. vii.

Board of Visitors.
Proposed for British Museum, *Rep.* IV., p. 3.
Greenwich Observatory reported on by, *Rep.* VIII., p. 1.

Boards of Studies.
For mathematics, sciences, &c., *Rep.* III., p. xxxvii.

Bodleian Library.
At Oxford, *Rep.* III., p. xxxviii.

Bonn.
Allusion to laboratory at, *Rep.* V., p. 6.

Bonney, Mr.
On election of professors, *Rep.* III., p. xxxiii.

Botanic Gardens.
At Oxford, *Rep.* III., p. xxxviii.
At Cambridge, *Rep.* III., p. xli.
At Edinburgh, *Rep.* IV. *App.*, p. 26; *Rep.* VIII., p. 1; *App.*, p. 49.
At Clifton College, Dulwich College, &c., *Rep.* VI. *App.*, p. 45–49.
At Glasgow, *Rep.* VII., p. 19.
At Dublin, *Rep.* IV., p. 15; *App.*, p. 26; *Rep.* VII., p. 33; *Rep.* VIII., p. 1; *App.*, p. 50.
See KEW GARDENS.

Botany.
Teaching of, in a village school, *Rep.* VI., p. 8.
Gardens administered under Government, *Rep.* VIII., p. 1.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.
See BRITISH MUSEUM, KEW GARDENS, &c.

Bristol Trade School.
Scientific instruction in, *Rep.* II., p. xxvi.

British Association.
Memorial from, relating to tidal observations, *Rep.* VIII., p. 21.

British Museum.
Administration, trustees, natural history collections, &c., *Rep.* IV., p. 1–10, 23.
Botanical collections of, *Rep.* IV., p. 8; *App.*, p. 26.
Duplicates from, might aid local museums, *Rep.* IV., p. 16.
Demonstrations to artizans, &c. in, *Rep.* IV., p. 18.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 25.

Brodie, Sir B.
On a small electing board for scientific appointments, *Rep.* III., p. xxx.
On pursuit of science, &c., *Rep.* III., p. lvi., lvii.

Bunning, Mr.
On Newcastle College of Science, *Rep.* V. *App.*, p. 34.

Bursaries.
See SCHOLARSHIPS AND EXHIBITIONS.

C.

Cambridge Philosophical Society.
Establishment, publications, &c. of, *Rep.* III., p. xli.

Cambridge University.
Examinations, &c. of, *Rep.* III., p. viii.–xxxvii.
Scholarships and fellowships in, *Rep.* III., p. xiii., xliii.–l.
Colleges in; their teaching, contributions to university, &c., *Rep.* III., p. xvi.–xxii., liii.
Additions to scientific professoriate at, *Rep.* III., p. xxviii.
Election, and emoluments, of professors at, *Rep.* III., p. xxxi.–xxxv.
Scientific institutions within, *Rep.* III., p. xxxviii.
Payments for demonstrators at, *Rep.* III. *App.*, p. lxi.
See also UNIVERSITIES OF OXFORD AND CAMBRIDGE.

Cape of Good Hope Observatory.
As a department of Government, *Rep.* VIII., p. 1.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.
Observatory wanted also for physical astronomy, *Rep.* VIII., p. 14.

Carpenter, Dr.
On early instruction in science, *Rep.* VI., p. 7.
Objection by, to a science council, *Rep.* VIII., p. 44.

Carruthers, Mr.
On the national botanical collections and library, *Rep.* IV., p. 4, 8; *App.*, p. 30.

Catholic Schools in Ireland.
Need of scientific teachers in, *Rep.* V., p. 28.

Catholic University of Ireland.
Establishment, resources, teaching of, &c., *Rep.* V., p. 25; *App.*, p. 36.

Celibacy.
As affecting university fellowships, *Rep.* III., p. xxxiv., xlvi.

Certificates.
In engineering, at Glasgow University, *Rep.* VII., p. 18.

Chancellor of the University of Cambridge.
Establishment of a physical laboratory by, *Rep.* III., p. xlii.

Charterhouse School.
Scientific instruction in, *Rep.* VI. *App.*, p. 16–54, 94, 153.

Cheltenham College.
Scientific instruction in, *Rep.* VI. *App.*, p. 19–58, 103, 147.

Chemical Department of the War Office.
As administered under Government, *Rep.* VIII., p. 1.

Chemistry.
University scholarship wanted for, *Rep.* III., p. xiv.
Additional professors of, wanted at Oxford and Cambridge, *Rep.* III., p. xxviii.
Catalogue of apparatus for teaching, *Rep.* VI. *App.*, p. 77.
Sketch of experiments in, *Rep.* VI. *App.*, p. 85.
Original researches in, in Germany, *Rep.* VIII., p. 23.

Children.
Instruction of, in science, *Rep.* II., p. xi.; *Rep.* VI., p. 3–10.

Chisholm, Mr.
On want of scientific advice by Standards Department, *Rep.* VIII., p 5.

Christ's Hospital.
Scientific instruction in, *Rep.* VI. *App.*, p. 19–61, 94, 141.

City of London School.
Scientific instruction in, *Rep.* VI. *App.*, p. 16–61, 98, 138.

Clifton College.
Scientific instruction in, *Rep.* VI. *App.*, p. 18–61, 103, 154.

Cole, Sir Henry.
On buildings in which science classes may be held, *Rep.* II., p. xxii.

Colleges in Universities.
Supply of funds by, for university purposes, *Rep.* III., p. xxxiv., liii.
Association of, for educational purposes, *Rep.* III., p. xvii., xxi.; *App.*, p. lxiv.
See OXFORD UNIVERSITY, &c.

Colleges (King's College, &c.)
Competition of State scientific institutions with, *Rep.* V., p. 10.
Advantage of, in centres of manufacture, *Rep.* V., p. 23.

Conservatoire des Arts et Métiers, Paris.
Importance of such a museum, *Rep.* IV., p. 14.
Lectures at, *Rep.* IV., p. 21, 22.

Continent.
Collections of scientific apparatus on the, *Rep.* IV., p. 13, 14.

Coomber, Mr.
On Bristol Trade School, *Rep.* II., p. xxvi.

Cooper's Hill College.
See INDIAN CIVIL ENGINEERING COLLEGE.

Council of India.
Want of scientific aid by, *Rep.* VIII., p. 2.

Council of Science for Government.
Should administer grants, not originate investigations, *Rep.* VIII., p. 22, 46.
Proposal to establish, *Rep.* VIII., p. 29.
Evidence in favour of, *Rep.* VIII., p. 30.
Evidence against, *Rep.* VIII., p. 41.
Remarks on evidence relating to, *Rep.* VIII., p. 45.

Council of Science for Universities.
For Oxford and Cambridge, *Rep.* III., p. xxv.

Cromwell, Rev. Canon.
On scientific instruction in colleges, &c., *Rep.* II., p. xii.–xiv., xvi.; *Rep.* VI., p. 7.

Cunningham, Mr. J. W.
On finances and State aid for King's College, *Rep.* V., p. 10, 11; *App.*, 30.

Cunningham, Professor.
On appliances for teaching at Queen's College, Belfast, *Rep.* VII., p. 38.

D.

Dalton, Rev. T.
On science teaching in schools, *Rep.* VI., *App.*, p. 55, 190.

Daubeny, Dr.
On science teaching in schools, *Rep.* VI., *App.*, p. 74.

Dawes, Dean.
Scientific instruction in school under, *Rep.* II., p. xi.

Dean.
For new Science School at South Kensington, *Rep.* I., p. vii.; *Rep.* I. *Supp.*, p. ix.

Dean of Durham.
On subscriptions to Newcastle College of Science, *Rep.* V., *App.*, p. 35.

Degrees.
Original research essential for obtaining, *Rep.* III., p. lix.; *Rep.* VII., p. 3.
Should only be for those well-grounded in science, *Rep.* VI., p. 2.
Increase of bodies for giving, in Scotland, undesirable, *Rep.* VII., p. 22.
See Edinburgh University, &c.

De la Rue, Mr.
On want of State laboratories, &c., *Rep.* VIII., p. 11, 14.
On increasing Government grant, *Rep.* VIII., p. 22.
On aid to scientific workers, *Rep.* VIII., p. 23.
On a minister of science and council of science, *Rep.* VIII., p. 28, 33, 40.

Demonstrators.
See Oxford University, &c.

Derby, The Right Hon. E. H. S., Earl of.
On want of accommodation at Edinburgh University, *Rep.*, VII., p. 12.
On duty of State to promote science, *Rep.* VIII., p. 8, 22.
Objection by, to a science council, *Rep.* VIII., p. 42.

Director.
For natural history department in British Museum, *Rep.* IV., p. 3.
For meteorology, *Rep.* VIII., p. 19.

Doctorate in Science.
Suggested, for Oxford and Cambridge, *Rep.* III., p. xiii., lvii., lix.
At London University; should be given only for research, *Rep.* VII., p. 3.
At Edinburgh University; research essential for, *Rep.* VII., p. 6; *App.*, p. 49–51.

Dublin Botanic Gardens.
See Botanic Gardens.

Dublin Museum.
Estimates for, in 1873–4, *Rep.* IV., p. 15; *App.*, p. 26.

Dublin University and Trinity College.
Course of study, examinations, professoriate, government, &c. at, *Rep.* VII., p. 29.

Dulwich College.
Scientific instruction in, *Rep.* VI. *App.*, p. 16–57, 127, 192.

Duncan, Professor.
On a council of science, *Rep.* VIII., p. 34.

Dundee.
Connection of Saint Andrew's University with, *Rep.* VII., p. 25.
Proposed foundation of a college at, *Rep.* VII., p. 26.

Duplicate Specimens.
From national museums, might be distributed to local museums, *Rep.* IV., p. 16.

Durham University.
Connexion of, with Newcastle College of Physical Science, *Rep.* V., p. 22.

E.

École Pratique des Hautes Études.
Approval of system of, *Rep.* III., p. lviii.

Edinburgh Botanic Garden.
See Botanic Gardens.

Edinburgh Museum.
Scientific collections of, &c., *Rep.* IV., p. 15; *Rep.* VII., p. 10.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 25.

Edinburgh Observatory.
As a department of Government, *Rep.* VIII., p. 1.
Expenditure for meteorology at, *Rep.* VIII., p. 20.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Edinburgh University.
Study of science, examinations, degrees, funds, &c. in, *Rep.* VII., p. 5.
Salaries and fees in, and estimates for, *Rep.* VII. *App.*, p. 45, 47, 54, 63–65
Papers relating to examinations, &c. in, *Rep.* VII., p. 46–67.
New buildings proposed for, *Rep.* VII. *App.*, p. 65.

Education Department.
Detrimental changes of, *Rep.* II., p. xiii., xiv., xvii.
Discouragement to science by, *Rep.* II., p. xiv.
Co-ordination of, with Science and Art Department, *Rep.* II., p. xxviii.

Election of Professors.
See Appointment of Professors.

Elementary Schools.
See Schools, Elementary.

Endowed Schools.
See Schools, Public and Endowed.

Endowed Schools Commission.
Promotion of scientific teaching by, *Rep.* VI., p. 3.
Letter respecting schemes of, *Rep.* VI. *App.*, p. 13.

Endowments.
See Income and Expenditure.

Engineering.
Instruction relating to, at Cambridge, *Rep.* III., p. xxviii.
Chair for, wanted at Oxford, *Rep.* III., p. xxviii.
At University College, *Rep.* V., p. 3.
At King's College, *Rep.* V., p. 8–11.
At Newcastle College, *Rep.* V., p. 22.
At Durham University, *Rep.* V., p. 23.
At Edinburgh, *Rep.* VII., p. 5, 6; *App.*, p. 49.
At Glasgow, *Rep.* VII., p. 5, 17; *App.*, p. 67.
At Dublin University, *Rep.* VII., p. 30.
At Queen's University, Ireland, *Rep.* VII., p. 36; *App.*, p. 74.

Estimates.
See Income and Expenditure.

Eton College.
Scientific instruction, laboratory, &c. at, *Rep.* VI., p. 5, 9; *App.*, p. 16–61, 45, 122, 186.

Evening Classes.
At King's College, *Rep.* V., p. 8, 10.
At Owens College, *Rep.* V., p. 16, 18.
At Andersonian Institution, *Rep.* VII., p. 21.
At Dundee, *Rep.* VII., p. 25.

Examinations.
Under Science and Art Department, *Rep.* II., p. xxii.
In universities, as affecting public schools, *Rep.* III., p. viii.
Injurious to research, *Rep.* III., p. lviii., lix.
In endowed schools; "leaving examinations" for, *Rep.* VI., p. 1.; *App.*, p. 61.
See Oxford University, &c.

Examination Papers.
Of Science and Art Department, *Rep.* II., p. xxiii.

Examiners.
Unconnected with professoriate, desirable in universities, *Rep.* VII., p. 7.

F.

Faraday, Professor.
On early instruction in science, *Rep.* VI., p. 8.

Farrar, Rev. F. W.
On science teaching in schools, *Rep.* VI., *App.*, p. 55.

Farrer, Mr.
On duty of State to encourage research, *Rep.* VIII., p. 9.
On scientific matters being controlled by Minister of Education, *Rep.* VIII., p. 28.
On advantage of a council of science, *Rep.* VIII., p. 31.

Faye, M.
On special establishments for astronomical physics, *Rep.* VIII., p. 17.

Fellowships.
Celibacy restrictions on, *Rep.* III., p. xxxiv.
At Oxford and Cambridge, *Rep.* III., p. xliv.
Alteration of tenure of, *Rep.* III., p. xlvi.; *App.* p. lxiv.
Original research considered in award of, *Rep.* III., p. xliv., l.; *Rep.* VII., p. 34.
At Trinity College, Dublin, *Rep.* VII., p. 31, 34.
See also SCHOLARSHIPS AND EXHIBITIONS.

Fitch, Mr.
On modern department in schools, *Rep.* VI., *App.*, p. 61.

Flower, Professor.
On lectures in British Museum, *Rep.* IV., p. 18.

Foster, Prof. G. C.
On teaching of physics, *Rep.* VI., *App.*, p. 68.

Fowler, Professor.
On annexation of professorships to fellowships, *Rep.* III., p. xxxv.

France.
Advanced scientific instruction in, *Rep.* III., p. lviii.
Original research in, *Rep.* III., p. lix.
State aid to science in, *Rep.* IV.; *App.*, p. 32.

Frankland, Dr.
On progress, &c., of original research, *Rep.* III., p. lviii., lix.; *Rep.* VIII., p. 8.
On Government requirements for chemistry, *Rep.* VIII., p. 5.
On want of State laboratories, observatories, and council of science, *Rep.* VIII., p. 10, 14, 31.

Friends' Boys' School, York.
Science teaching in, *Rep.* VI. *App.*, p. 196.

Froude, Mr.
On scientific experiments in relation to ships, *Rep.* VIII., p. 3.
Objection of, to scientific advice by committees, *Rep.* VIII., p. 3.

G.

Galton, Captain Douglas.
On Government in relation to science, *Rep.* VIII., p. 3.
On desirability of having a council of science, *Rep.* VIII., p. 37, 39.

Geikie, Professor.
On want of accommodation in Edinburgh University and Museum, *Rep.* VII., p. 10, 11.

Geological Survey of the United Kingdom.
No necessary connexion between, and Royal School of Mines, *Rep.* I., p. vii.
Want of office accommodation for, in Jermyn Street, *Rep.* I., p. vii.; *Rep.* IV., p. 11.
Estimates for, in 1874–5, *Rep.* VII. *App.*, p. 49.
As a department of Government, *Rep.* VIII., p. 1.

Geological Survey, Scotland.
Fossils collected by, *Rep.* VII., p. 10.

Geology.
Scholarships for, *Rep.* III., p. xiv.
Chair of, should be separate from natural history, *Rep.* VII., p. 20, 38, 40.

Germany.
"Abiturienten Examen" system in, *Rep.* III., p. ix.
Plurality of university teachers in, *Rep.* III., p. xxvi.
Advanced scientific instruction in, *Rep.* III., p. lviii.
Progress of original research in, *Rep.* III., p. lviii., lix.
Chemical researches in, *Rep.* VIII., p. 23.

Gladstone, Right Hon. W. E., M.P.
On university reform, *Rep.* III., *App.*, p. lxv.

Glaisher, Mr.
Meteorological reports by, *Rep.* VIII., p. 20, 26.

Glasgow University.
Scientific curriculum, funds, teaching, &c. in, *Rep.* VII., p. 5, 15–21.
Salaries in, and estimates for, *Rep.* VII. *App.*, p. 45.
Papers relating to, *Rep.* VII. *App.*, p. 67–70.

Gore, Mr.
On want of a State scientific department, laboratories, &c., *Rep.* VIII., p. 12, 28.
On importance of aiding scientific investigators, *Rep.* VIII., p. 23.

Government.
Competition of colleges under, with King's College, &c., *Rep.* V., p. 10, 11.
Aid of, wanted for King's College, University College, Owens College, &c., *Rep.* V., p. 12, 21, 24.
How it can aid science teaching, *Rep.* VI. *App.*, p. 60.
Scientific work carried on under, *Rep.* VIII., p. 1.
Assistance given, and desirable to be given, by, for research, *Rep.* VIII., p. 6, 8.
Organization best calculated to determine scientific questions of, *Rep.* VIII., p. 27.
In relation to Meteorological Office, Rep. VIII., p. 17.
Summary of functions of, relative to science, *Rep.* VIII., p. 27.

Government Grants.
See GRANTS FOR SCIENCE.

Government (French).
Aid of, to science, *Rep.* IV., *App.* p. 32.

Grant, Professor.
On enlarging Royal Society Government Grant, *Rep.* VIII., p. 22.

Grants for Science.
Under Science and Art Department, *Rep.* II., p. xxii.
To Scottish Universities, *Rep.* VII., p. 5.
To Geographical and Royal Societies, *Rep.* VIII., p. 6, 21.
To Andersonian Institution, *Rep.* VII., p. 21.
To scientific societies, for extension of research, *Rep.* VIII., p. 23.
To scientific workers, *Rep.* VIII., p. 26.
See also INCOME AND EXPENDITURE.

Greek.
In university education, *Rep.* III., p. x.

Greenwich Observatory.
As a department of Government, *Rep.* VIII., p. 1.
In relation to physical astronomy, *Rep.* VIII., p. 14, 15.
Expenditure for meteorology at, *Rep.* VIII., p. 20.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Greenwood, Professor.
On courses of study, &c., at Owen's College, *Rep.* V. p. 15–18; *App.*, p. 32.

Gresham College.
Scientific lectures at, *Rep.* VI. *App.*, p. 128.

Griffith, Mr.
On "leaving examinations" for schools, *Rep.* VI. *App.*, p. 61.

Grove, Mr. Justice.
On appointment of a council of science, *Rep.* VIII., p. 38.

Günther, Dr.
On lectures in British Museum, duplicates, &c., *Rep.* IV., p. 17, 18.

H.

Hale, Rev. E.
On teaching of science, &c. in schools, *Rep.* VI. *App.*, p. 55, 56, 71, 191.

Harrow School.
Scientific instruction in, *Rep.* VI. *App.*, p. 5, 17–61, 128, 184.

Henry, Professor.
On importance of aiding scientific workers, *Rep.* VIII., p. 23.

Henslow, Professor.
Scientific instruction in school under, *Rep.* II., p. xi.; *Rep.* VI., p. 8.

Herbaria.
At Oxford, *Rep.* III., p. xl.
Of British Museum and Kew, *Rep.* IV., p. 4–10; *App.*, p. 31.

Hilgard, Professor.
On a State observatory for astronomical physics, *Rep.* VIII., p. 15.

Honours.
Gained by public school science students, *Rep.* VI. *App.*, p. 200.

Hooker, Dr.
On Kew Gardens, *Rep.* IV., p. 7; *App.*, p. 26.
On teaching botany in a village school, *Rep.* VI., p. 8.
On desirability of having a council of science, *Rep.* VIII., p. 33.

Hooker, Sir Wm. J.
Connexion of, with Kew Gardens, *Rep.* IV., p. 7.

Hunterian Museum.
  See Royal College of Surgeons.

Hunterian Museum, Glasgow.
  Anatomical department, &c. in, *Rep.* VII., p. 19.

Hyde Institute.
  At Oxford; foundation of, &c., *Rep.* III., p. xxxviii.

Hydrographical Survey.
  As a department of Government, *Rep.* VIII., p. 1.
  Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

I.

Income and Expenditure.
  Re-arrangement of payments in elementary schools desirable, *Rep.* II., p. xvi.
  At Oxford University, *Rep.* III., p. xxxix.; *App.*, p. lxi.
  Contributions of colleges to university, *Rep.* III., p. xxxiv., liii.
  At Cambridge University, *Rep.* III. *App.*, p. lxi.
  Accumulation of funds in Patent Office, *Rep.* IV., p. 14.
  Estimates for museums, in 1873–4, *Rep.* IV. *App.*, p. 25.
  Funds for teaching science in schools, *Rep.* VI., p. 4; *App.*, p. 57.
  In Scottish universities, for 1875–6, *Rep.* VII. *App.*, p. 44.
  Estimates for Government scientific departments, *Rep.* VIII., p. 2; *App.*, p. 49.
  Expenditure for meteorology, *Rep.* VIII., p. 17, 20.
  Salaries for scientific workers, *Rep.* VIII., p. 23.
  See Oxford University, Owens College, &c.

India.
  Advantage of a council of science for matters relating to, *Rep.* VIII., p. 2, 35, 37.
  Physico-astronomical observatory wanted in, *Rep.* VIII., p. 14.

Indian Civil Engineering College, Cooper's Hill.
  Professorial stipends, &c. at, *Rep.* V., p. 11; *App.*, p. 38.

Inspection.
  For provincial museums, *Rep.* IV., p. 18.
  Under Science and Art Department, *Rep.* II., p. xxv.

Ireland.
  Imperfect appreciation of higher education in, *Rep.* V., p. 28.

Iselin, Mr.
  On failures in science examinations, *Rep.* II., p. xxv.

J.

Jarmain, Mr.
  On early instruction in science, *Rep.* VI., p. 7.

Jellett, Professor.
  On a council of science, *Rep.* IV., p. 38.
  On lectures, &c. at Trinity College, Dublin, *Rep.* VII., p. 30–33.

Jenkin, Professor F.
  On an elective board for science, *Rep.* VIII., p. 34.

Jodrell Professorship of Physiology.
  At University College, *Rep.* V., p. 3.

Jones, Mr. Winter.
  On sending out duplicates from British Museum, *Rep.* IV., p. 17.
  On lectures by museum keepers, *Rep.* IV., p. 18.

Joule, Dr.
  On carrying on tidal observations, *Rep.* VIII., p. 20.
  On aid to scientific workers, *Rep.* VIII., p. 23.

Jowett, Professor.
  On importance of fellowships, *Rep.* III., p. xliv.
  On scientific investigators, *Rep.* III., p. xlvi.
  On difficulty in retaining university teachers, *Rep.* III., p. xlvi.

K.

Kane, Sir Robert.
  On Queen's University, *Rep.* VII., p. 36–39.

Kew Gardens.
  Collections of, with reference to South Kensington Museum and British Museum, &c., *Rep.* IV., p. 5, 8, 23, 25.
  Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 25.
  Documents relating to, *Rep.* IV. *App.*, p. 26.
  As a department of Government, *Rep.* VIII., p. 1.

King's College, London.
  Foundation, endowments, lectures, students, &c. of, *Rep.* V., p. 7; *App.*, p. 30.
  Memorial from, respecting Indian appointments, *Rep.* V., p. 11.

King's College School.
  Flourishing condition of, *Rep.* V., p. 10.
  Relation of, to the College, *Rep.* V. *App.*, p. 32.
  Scientific instruction in, *Rep.* VI. *App.*, p. 18–61, 127, 178.

L.

Laboratories.
  In Royal School of Mines, *Rep.* I., p. vii.
  At Oxford and Cambridge Universities, *Rep.* III., p. xxxviii.–xlii., lvii.
  In Glasgow University, *Rep.* III., p. lviii.; *Rep.* VII., *App.*, p. 69.
  For research, proposed, *Rep.* III., p. lviii.
  In endowed schools, *Rep.* V., p. 1, 3–5.
  At University College Birkbeck Chemical Laboratory, *Rep.* V., p. 6.
  At Catholic University of Ireland, *Rep.* V., p. 26; *App.*, p. 37.
  At Rugby, Dulwich, Harrow, &c., *Rep.* VI. *App.*, p. 36–43.
  At Edinburgh University, *Rep.* VII., p. 12; *App.*, p. 58.
  At Trinity College, Dublin, *Rep.* VII., p. 33.
  In Queen's Colleges, Ireland, *Rep.* VII., p. 38, 39.
  At Saint Andrew's University, *Rep.* VII. *App.*, p. 71.
  Institution of, by Government, *Rep.* VIII., p. 4, 9, 13.
  Remarks on evidence relating to, *Rep.* VIII., p. 24.

Lancashire, East.
  Group of evening classes in, *Rep.* II., p. xxvii.

Latin.
  In University education, *Rep.* III., p. x.

Lecturers in Natural Science.
  Employment of, in universities, *Rep.* III., p. li.

Lectures.
  For science teachers under Department, *Rep.* II., p. xxi.
  Combined collegiate, in universities, *Rep.* III., p. xvii., xxi.; *App.*, p. lxiv.
  At Berlin University, *Rep.* III., p. xxiii.
  In connexion with museums, *Rep.* IV., p. 18.
  On science, wanted at great centres, *Rep.* IV., p. 21.
  See King's College, Oxford University, &c.

Lee's Readerships.
  At Oxford University, *Rep.* III., p. xvii., lii.

Leinster Lawn, Dublin.
  Estimate for, 1873–4, *Rep.* IV. *App.*, p. 26.

Libraries.
  At South Kensington Museum, *Rep.* IV., p. 4, 13.
  Of Museum of Practical Geology, *Rep.* IV., p. 10.
  At Dublin, *Rep.* IV., p. 15.
  At University College, *Rep.* V., p. 4.
  At Saint Andrew's University, *Rep.* VII., p. 23.
  See Radcliffe Library, Bodleian Library, &c.

Linacre Professor of Physiology.
  At Oxford; too many subjects assigned to him, *Rep.* III., p. xxvi.

Lindley, Dr.
  On Kew Gardens, *Rep.* IV., p. 6.

Lingen, Mr.
  On extra subjects in elementary schools, *Rep.* II., p. xv.

Literature.
  Connection of, with science, in universities, *Rep.* III., p. x.

Lockyer, J. N., Esq.
  On State aid to science in France, *Rep.* IV. *App.*, p. 32.
  On scientific instruction in public schools, *Rep.* VI., p. 1; *App.*, p. 14.

London University.
  Foundation, government, studies, expenses, &c. of, *Rep.* III., p. ix., *Rep.* VII., p. 1.
  Owens College courses adapted for, *Rep.* V., p. 19.
  Papers relating to, *Rep.* VII. *App.*, p. 43.

Lord President.
  Proposal to place British Museum under, *Rep.* IV., p. 3.

Lyons, Dr.
  On stipends &c., at Catholic University of Ireland, *Rep.* V., p. 26; *App.*, p. 37.

Lyttelton, Lord.
On schemes of Endowed Schools Commission, *Rep.* VI., *App.*, p. 13.

M.

Madan, Mr.
On science teaching in schools, *Rep.* VI., *App.*, p. 55, 56, 59, 61, 188.

Main, Rev. R.
On Radcliffe Observatory, *Rep.* III., p. xl., *App.*, p. lxii.

Manchester.
Valuable museums in, *Rep.* IV., p. 15.

Manchester Grammar School.
Scientific instruction in, *Rep.* VI. *App.*, p. 20–61, 179.

Marlborough College.
Scientific instruction in, *Rep.* VI. *App.*, p. 19–61, 127, 130.

Maskelyne, Professor.
On British Museum specimens, *Rep.* IV., p. 11, 17.
On lectures by museum keepers, *Rep.* IV., p. 19.

Massachusetts Institute of Technology.
Reference to, *Rep.* VI., p. 5.

Mathematics.
Want of a chair of, in Royal School of Mines, *Rep.* I., p. vii.
University prizes for, *Rep.* III., p. xiv.
Additional chairs for, desirable, at Oxford, *Rep.* III., p. xxviii.

Mechanical Inventions.
Proposals for a museum of, &c., *Rep.* IV., p. 14, 20.

Mechanics and Engineering.
Chair for, at Oxford, desirable, *Rep.* III., p. xxviii.

Mechanics' Institutions.
Subscriptions from, to Birkbeck Chemical Laboratory, *Rep.* V., p. 6.

Medicine.
Fellowship for, *Rep.* III., p. xiv.
Chair of, should be separate, *Rep.* III., p. xxvii.
At University College, *Rep.* V., p. 3.
At King's College, *Rep.* V., p. 8.
At Catholic University of Ireland, *Rep.* V., p. 27.
At Owens College, *Rep.* V., p. 15.
At Newcastle-on-Tyne, *Rep.* V., p. 22; *App.*, p. 35.
At London University, *Rep.* VII., p. 3.
At Edinburgh University, *Rep.* VII., p. 6; *App.* p. 51–53, 56, 60, 64.
At Aberdeen University, *Rep.* VII., p. 27; *App.* p., 73.
At Dublin University, Rep. VII., p. 30.
At Queen's University, Ireland, *Rep.* VII., p. 36, 38; *App.*, p. 74.
In Scottish Universities, *Rep.* VII., p. 5.

Merchant Taylors' School.
No scientific instruction in, at present, *Rep.* VI. *App.*, p. 122, 130.

Meteorological Observations.
At Dublin University, *Rep.* VII., p. 33.
Conducted under Government, *Rep.* VIII., p. 1.
Present system of, *Rep.* VIII., p. 17.
Aid wanted for physical, not for climatic, meteorology, *Rep.* VIII., p. 19.
Remarks on evidence relating to, *Rep.* VIII., p. 25.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Meteorological Office.
Its relation to Government, &c., *Rep.* VIII., p. 1, 17–20.

Meteorological Society.
Arrangements between, and Meteorological Office, *Rep.* VIII., p. 20.
See SCOTTISH METEOROLOGICAL SOCIETY.

Meteorologist Royal.
Proposal to appoint, *Rep.* VIII., p. 19.

Milne-Home, Mr.
On a science council for Scotland, *Rep.* VIII., p. 38.

Mining Record Office.
Insufficient accommodation in, removal of, &c., *Rep.* I., p. vii.

Minister of Education.
As controller of Government scientific matters, *Rep.* VIII., p. 28.

Minister of Science.
Proposal to appoint, *Rep.* VIII., p. 27.
Remarks on evidence relating to, *Rep.* VIII., p. 45.

"Modern Side."
In public schools, *Rep.* VI., *App.*, p. 61.

Moseley, Canon.
On teaching science in elementary schools, *Rep.* II., p. xii., xv.

Museum of Mechanical Inventions.
Proposal to form; lectures in, &c., *Rep.* IV., p. 14, 20.

Museum of Natural History, Dublin.
Administered by Royal Dublin Society, *Rep.* IV., p. 15.

Museum of Patents.
See PATENT MUSEUM AT SOUTH KENSINGTON.

Museum of Practical Geology.
Its collections, library, want of accommodation, &c., *Rep.* I., p. vii.; *Rep.* IV., p. 10.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 25.

Museums in Universities, Colleges, and Schools.
Should be available for research, *Rep.* III., p. lix.
See OXFORD UNIVERSITY, RUGBY SCHOOL, &c.

Museums, generally.
Want of, for exhibition of scientific apparatus, *Rep.* IV., p. 13.
Provincial; aid to, &c., *Rep.* IV., p. 15–24.
Typical, might be sent out from London, *Rep.* IV., p. 17.
Inspection of, *Rep.* IV., p. 18.
Public lectures in connexion with, *Rep.* IV., p. 18–22.
See BRITISH MUSEUM.

N.

Natural History.
Chair of, at Glasgow, and at Queen's College, Belfast, should be divided, *Rep.* VII., p. 20, 38, 40.

Natural Philosophy.
University prizes for, *Rep.* III., p. xiv.

Naturalists.
Proposed, to collect specimens, &c., for museums, *Rep.* IV., p. 17.

Navy.
Researches in connexion with, *Rep.* VIII., p. 2, 5, 7.

Newcastle-upon-Tyne.
Medical school at, *Rep.* V., p. 22.
College of Physical Science at, *Rep.* V., p. 22; *App.*, p. 34.

New Code.
See REVISED CODE.

Northcote, The Right Honorable Sir Stafford.
On duty of State to promote science, *Rep.* VIII., p. 8.
Objection by, to a science council, *Rep.* VIII., p. 44.

O.

Observatories.
At Cambridge, *Rep.* III., p. xli.
At Durham University, *Rep.* V., p. 22.
At Rugby, Eton, and Rossall, *Rep.* VI. *App.*, p. 43.
At Glasgow University, *Rep.* VII., p. 19.
At Dublin University, *Rep.* VII., p. 33.
At Edinburgh, *Rep.* VIII., p. 1, 20; *App.*, p. 49.
Should be instituted by Government, *Rep.* VIII., p. 9, 13–17.
Remarks on evidence relating to, *Rep.* VIII., p. 25.
See CAPE OF GOOD HOPE, GREENWICH, &c.

Original Research.
As part of the functions of a professor, *Rep.* III., p. xxxi.; *Rep.* VII., p. 14.
A primary duty of universities, *Rep.* III., p. lvi.
Award of fellowships for, *Rep.* III., p. xliv., l., lvii. *Rep.* VII., p. 34.
Laboratories and observatories for, *Rep.* III., p. lvii. *Rep.* VIII., p. 4, 9.
System of examination injurious to, *Rep.* III., p. lviii., lix.
Should be required for degrees, *Rep.* III., p. lix.; *Rep.* VII., p. 3.
Insufficient appliances for, in Government departments, *Rep.* VIII., p. 4.
Duty of State to encourage, *Rep.* VIII., p. 8, 22.
Grant for, to Royal Society, *Rep.* VIII., p. 6.
Aid for workers in, *Rep.* VIII., p. 22.
Pursuit of, abroad, *Rep.* VIII., p. 24.
Remarks on evidence relating to, *Rep.* VIII., p. 24.

Owen, Professor.
On the national herbaria, *Rep.* IV., p. 8.
On British Museum duplicates, lectures, &c., *Rep.* IV., p. 17–18.
On Royal Society Government Grant, *Rep.* VIII., p. 22.
On a minister of science, *Rep.* VIII., p. 27, 41.

Owens College, Manchester.
Origin, endowments, teaching, &c., *Rep.* V., p. 13; *App.*, p. 32.

Oxford University.
Examinations of, &c., *Rep.* III., p. viii.–xxxvii.
Scholarships and fellowships in, *Rep.* III., p. xiii., xliii.–l.
Colleges in, their teaching, contributions to university, &c., *Rep.* III., p. xvii.–xxii., liii.
Additions to scientific professoriate at, *Rep.* III., p. xxvi.
Adjoint professors, demonstrators, and assistants at, *Rep.* III., p. xxviii.
Election, and emoluments, of professors at, *Rep.* III., p. xxxi.–xxxv.
Museum, and other scientific institutions within, *Rep.* III., p. xxxviii.
Position and requirements of biology in, *Rep.* III. *App.*, p. lxi.
See also UNIVERSITIES OF OXFORD AND CAMBRIDGE.

P.

Patent Museum at South Kensington.
Bad accommodation for, &c., *Rep.* IV., p. 13.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 25.

Patent Office.
Accumulation of funds at, *Rep.* IV., p. 14.

Patents.
In relation to scientific discoverers, *Rep.* VIII., p. 23.

Pattison, Rev. M.
On, freedom of study for university scientific students, *Rep.* III., p. x., xii.
On increased number of chairs of science, *Rep.* III., p. xxviii.
On university fellowships, *Rep.* III., p. xliv.

Payments on Results.
Under Science and Art Department, *Rep.* II., p. xxv.

Pensions.
For university professors, *Rep.* III., p. xxxiv.
For scientific workers, *Rep.* VIII., p. 23.

Percival, Rev. J.
On science teaching in schools, *Rep.* VI. *App.*, p. 55.
On aid of universities to public schools, *Rep.* VI. *App.*, p. 60.

Phillips, Professor.
On British museum supplying typical collections, *Rep.* IV., p. 17.
On science teaching in schools, *Rep.* VI. *App.*, p. 75.
On a council of science, *Rep.* VIII., p. 39.

Physics.
University scholarship for, *Rep.* III., p. xiv.
Professorships of, at Oxford and Cambridge, *Rep.* III., p. xxvi., xxviii.
Catalogue of apparatus for teaching, *Rep.* VI. *App.*, p. 77.
Sketch of experiments in, *Rep.* VI. *App.*, p. 85.

Physiology.
Chair of, should be special, *Rep.* III., p. xxvi.
Professorship of, for Cambridge, *Rep.* III., p. xxviii.
Endowment of, at University College, *Rep.* V., p. 3.

Playfair, Right Hon. Lyon.
On laboratories at Edinburgh University, *Rep.* VII., p. 12.

Practical Instruction.
Want of, in Royal School of Mines, *Rep.* I., p. vii.
Of science teachers, *Rep.* I., p. viii.; *Rep.* I. *Supp.*, p. ix.; *Rep.* II., p. xx.
At Oxford University, *Rep.* III., p. xvii.
In Berlin University, *Rep.* III., p. xxv.
In relation to scientific instruction, *Rep.* V., p. 23.

Prælector of Physiology.
At Cambridge; position of, *Rep.* III., p. xxii., xxviii.

Price, Professor.
On Museum of Oxford, *Rep.* III., p. xxxviii.

Pritchard, Rev. C.
On astronomical physics at Oxford, *Rep.* III. *App.*, p. lxiii.

Prizes for Science.
Under Science and Art Department, *Rep.* II., p. xxiii.

Professors.
Council of, for new Science School at South Kensington, *Rep.* I., p. vii.; *Rep.* I. *Supp.*, p. ix.
See OXFORD UNIVERSITY, &c.

Provostship.
Of Trinity College, Dublin, *Rep.* VII., p. 31.

Public Health.
Degrees in, at Edinburgh, *Rep.* VII. *App.*, p. 53.

Public Schools.
See SCHOOLS, PUBLIC AND ENDOWED.

Public Schools Act, 1868.
Commission under; its regulations for scientific instruction, *Rep.* VI., p. 9.

Public Schools Commissions.
Recommendations of, respecting science teaching, *Rep.* VI., p. 2–10.

Purser, Professor.
On Queen's College, Belfast, *Rep.* VII., p. 38, 39.

Q.

Queen's College, Belfast.
Salaries, students, &c. in, *Rep.* VII., p. 35, 38; *App.*, p. 74.

Queen's College, Cork.
Salaries, students, &c. in, *Rep.* VII., p. 35, 38, 39; *App.*, p. 74.

Queen's College, Galway.
Students, salaries, &c. in, *Rep.* VII., p. 35, 38, 39; *App.*, p. 74.

Queen's University, Ireland.
Foundation, colleges, studies, scholarships, &c. at, *Rep.* VII., p. 35; *App.* p. 73.

R.

Radcliffe Library.
At Oxford, *Rep.* III., p. xxxvii.

Radcliffe Observatory.
At Oxford, *Rep.* III., p. xxxviii., xl.; *App.* p. lxii.

Ramsay, Professor.
On early instruction in geology, *Rep.* VI., p. 6.

Rankine, Professor.
On engineering course at Glasgow, *Rep.* VII., p. 17–19.
On scientific workers holding office, *Rep.* VIII., p. 24.
Objection of, to a permanent council of science, *Rep.* VIII., p. 41.

Rawlinson, Sir Henry.
On scientific questions relating to India, *Rep.* VIII., p. 2.
On a council of science, *Rep.* VIII., p. 35.

RECOMMENDATIONS AND CONCLUSIONS OF THE COMMISSION.

ARTIZANS.
Lectures for, to be continued at Museum of Practical Geology, *Rep.* I., p. vii.
Lectures for, on applications of science, *Rep.* IV., p. 24.

ASTRONOMICAL PHYSICS.
An observatory, specially devoted to, should be founded, *Rep.* VIII., p. 41.

BOARD OF TRADE.
Mining Record Office to be lodged with Statistical Department of, *Rep.* I., p. vii.

BRITISH MUSEUM.
1. Change in administration of natural history collections.
2. Director to be appointed by the Crown; keeper, &c. by minister.
3. Present superintendent to be first director.
4. Board of visitors to be constituted.
5. Botanical collection to be arranged with reference to geographical distribution and palæontology.
6. To distribute duplicate specimens.
Rep. IV., p. 3, 17, 23.

Recommendations and Conclusions—*cont.*

CATHOLIC UNIVERSITY OF IRELAND.
  Grant not recommended for, *Rep.* V., p. 28.

CHILDREN.
  In schools, to receive instruction in science, *Rep.* II., p. xvi., xix.

COUNCIL OF SCIENCE.
  For Oxford and Cambridge Universities, *Rep.* III., p. xxv.–xxxvii.

COUNCIL OF SCIENTIFIC ADVICE FOR GOVERNMENT.
  To be appointed; functions of Government Grant Committee to be transferred to it; not to initiate investigations, *Rep.* VIII., p. 46, 47.

DEAN.
  For new South Kensington Science School, *Rep.* I., p. vii., and *Rep.* I. *Supp.*, p. ix.

DOCTORATE IN SCIENCE.
  To be given only on proof of research, *Rep.* VII., p. 3.

DUBLIN UNIVERSITY.
  1. Original research to be essential for fellowships.
  2. Scholarships to be awarded for science.
    Rep. VII., p. 34.

EDINBURGH UNIVERSITY.
  1. Has a claim to increased State aid.
  2. Should receive a capital sum and an annual grant.
  3. Capital sum to be dependent on private contributions.
  4. Expenditure to be subject to parliamentary control.
    Rep. VII., p. 14, 28.

EDUCATION DEPARTMENT.
  Co-ordination with Science and Art Department to continue, *Rep.* II., p. xxviii.

EXAMINATIONS.
  "Leaving" preferable to matriculation examination for Oxford and Cambridge, *Rep.* III., p. ix.

FELLOWSHIPS.
  To be re-modelled, freed from celibacy restriction, and given for original research, *Rep.* III., p. xliv.–lvii.

GEOLOGICAL SURVEY OFFICE.
  To remain in Jermyn Street, *Rep.* I., p. vii.

GLASGOW UNIVERSITY.
  1. Natural history chair to be divided, and provision made for a new professorship.
  2. Increased payments to be made for assistants.
  3. Scientific professors' salaries to be revised.
  4. State grant to be increased, and under parliamentary control.
    Rep. VII., p. 20, 28.

GOVERNMENT AID TO SCIENCE.
  1. Present aid is inadequate.
  2. To be given in aid of laboratories, &c. for scientific investigations.
  3. To be given in aid of physical meteorology, terrestrial and astronomical physics, and tidal phenomena.
  4. To be given in aid of private investigators.
  5. By increase of Royal Society's grant.
  6. By institution of a ministry and council of science.
    Rep. VIII., p. 46, 47.

GOVERNMENT GRANT FUND.
  May be considerably increased with advantage, *Rep.* VIII., p. 47.

INVESTIGATORS.
  Should be remunerated for their time and labour, *Rep.* VIII., p. 47.

KEW GARDENS.
  1. Collections to be arranged with reference to systematic botany.
  2. To receive recent plants from Government expeditions.
  3. To aid investigations in physiological botany.
    Rep. IV., p. 23.

KING'S COLLEGE, LONDON.
  1. To have State aid; grants to depend on subscriptions.
  2. Hospital Medical Department and Day School finances to be kept distinct.
  3. Grant to be conditional on a new charter abolishing religious restrictions, &c.
    Rep. V., p. 12.

Recommendations and Conclusions—*cont.*

LABORATORIES.
  Ought to be provided by the Government, *Rep.* VIII., p. 47.
  To be added to new Science School at South Kensington, *Rep.* I., p. vii.

HYDE INSTITUTE, OXFORD.
  Physical apparatus imperfect, *Rep.* III., p. xxxix.

LECTURES, PUBLIC.
  To artizans; to be given on applications of science, *Rep.* I., p. vii.; *Rep.* IV., p. 24.
  To be given on general principles of science, *Rep.* IV., p. 24.

LITERATURE.
  Not antagonistic to science in education, *Rep.* III., p. vii.

MATHEMATICS.
  To be added to Royal School of Mines' instruction, *Rep.* I., p. vii.

MINING RECORD OFFICE.
  To be lodged with Statistical Department, or in College of Chemistry premises, *Rep.* I., p. vii.

MUSEUM OF PRACTICAL GEOLOGY.
  To be kept for Museum and Geological Survey purposes only. Working men's lectures to continue, *Rep.* I., p. vii.

MUSEUMS, PROVINCIAL.
  To be connected with Science and Art Department, *Rep.* IV., p. 23.

NEWCASTLE COLLEGE OF PHYSICAL SCIENCE.
  May soon establish a claim to Government aid, *Rep.* V., p. 24.

OBSERVATORIES.
  Should be established and maintained by the Government, *Rep.* VIII. p. 47.

ORIGINAL RESEARCH.
  To be promoted in universities by—(1) a scientific professoriate; (2) fellowships; (3) special laboratories; (4) increased museums; (5) doctorate in science, *Rep.* III., p. lvii.
  To be promoted by State aid to laboratories, private investigators, &c., *Rep.* VIII., p. 46, 47.

OWENS COLLEGE.
  To receive Government aid, *Rep.* V., p. 21.

PENSIONS.
  To be instituted for University Professors, *Rep.* III., p. xxxiv.

PROFESSORS.
  Plurality of, indispensable, *Rep.* III., p. xxvi.
  To be elected by small boards, *Rep.* III., p. xxxiii.

PROFESSORSHIPS.
  Additional, for Oxford and Cambridge, *Rep.* III. p. xxvi.–xxx.

QUEEN'S UNIVERSITY, IRELAND.
  1. Colleges to have increased grant for assistants, &c.
  2. Geology to be separated from natural history chair at Belfast.
    Rep. VII., p. 40.

RELIGION.
  Restrictions of, should be abolished at King's College, *Rep.* V., p. 12.

RESEARCH (ENDOWMENT OF).
  Aid may properly be given for the, by the State, *Rep.* VIII., p. 47.

REVISED CODE.
  Gives insufficient encouragement to science, *Rep.* II., p. xix.

ROYAL COLLEGE OF CHEMISTRY.
  1. To vacate premises in Oxford Street, *Rep.* I., p. vii.
  2. Teaching in, to be rendered more efficient, *Rep.* I., p. vii.
  3. To be consolidated with Royal School of Mines, *Rep.* I., p. vii.

ROYAL COLLEGE OF SURGEONS' MUSEUM.
  To be aided by the State, and not removed to South Kensington, *Rep.* IV., p. 4, 23.

Recommendations and Conclusions—*cont.*

ROYAL SCHOOL OF MINES.
1. Teaching in, to be rendered more efficient, *Rep.* I., p. vii.
2. To be consolidated with College of Chemistry, *Rep.* I., p. vii.

ROYAL SCHOOL OF NAVAL ARCHITECTURE.
Instruction of, to be given in new Science School at South Kensington, *Rep.* I., p. vii.

SAINT ANDREW'S UNIVERSITY.
1. Staff and appliances to be sufficient for proper teaching of science.
2. Classes at Dundee not to be affiliated.
3. Scientific chairs not to be transferred to Dundee.
4. Government grant to be increased; expenditure being submitted to Parliament.
5. Salaries of scientific professors to be revised. *Rep.* VII., p. 25, 26.

SCHOLARSHIPS IN NATURAL SCIENCE.
To be founded at Oxford and Cambridge, *Rep.* III., p. xiii.

SCHOOLS, ELEMENTARY.
Science to be taught to children and pupil-teachers, *Rep.* II., p. xvi., xix.

SCHOOLS, PUBLIC AND ENDOWED.
1. To devote not less than six hours a week to science.
2. One sixth of examination marked to be allotted to science.
3. Same proportion for leaving examinations. *Rep.* VI., p. 10.

SCIENCE AND ART DEPARTMENT.
1. To work in harmony with general elementary education.
2. To continue co-ordinate with Education Department.
3. To have a more efficient system of inspection.
4. Teachers to be recognized as Elementary Science Teacher, Second Grade Science Master, and First Grade Science Master.
5. Payments for results to be rated according to certificate held by teacher.
6. Practical instruction and practical examination for teachers.
7. Examinations for teachers to be conducted by Department examiners.
8. To give training-college students the opportunity of remaining a third year.
9. To encourage employment of assistant teachers.
10. Exhibitions to be offered to encourage first-grade science teachers.
11. Extended grants to be given for buildings, laboratories, apparatus, &c.
12. To encourage formation of science schools, and scientific instruction in grammar schools, &c.
13. To organize typical museums, and aid and inspect provincial museums. *Rep.* II., p. xxviii.–xxx.; *Rep.* IV., p. 23.

SCIENCE SCHOOL AT SOUTH KENSINGTON.
1. To be formed out of Royal School of Mines and College of Chemistry.
2. Science teachers to be instructed therein.
3. Respecting organization of, and accommodation in, *Rep.* I., p. vii., viii.; *Rep.* I. *Supp.*, p. ix.

SCIENCE TEACHERS.
To receive instruction in new Science School at South Kensington, *Rep.* I., p. viii.

SCOTLAND.
Number of degree-giving bodies not to be increased, *Rep.* VII., p. 22.

SCOTTISH UNIVERSITIES.
Two classes to be recognized in natural science honors' list, *Rep.* VII., p. 5, 28.
Grants to be accounted for to Government, *Rep.* VII., p. 28.

SOUTH KENSINGTON MUSEUM.
1. To form a collection of physical and mechanical instruments.
2. Its scientific collections to be placed under a minister. *Rep.* IV., p. 23.

TIDAL PHENOMENA.
An organization should be established for the observation of, and for the reduction of the observations, *Rep.* VIII., p. 47.

TRAINING COLLEGES.
System to be modified for scientific instruction, *Rep.* II., p. xix.

Recommendations and Conclusions—*cont.*

UNIVERSITY COLLEGE, LONDON.
1. To receive State aid; grants to depend on subscriptions.
2. Finances of hospital, medical department, and day school to be kept distinct. *Rep.* V., p. 12.

UNIVERSITIES.
Much still to be done for science in, *Rep.* III., p. lx.

Reed, Mr. E. J.
On scientific investigation relating to ships, *Rep.* VIII., p. 4.
On a council of science, *Rep.* VIII., p. 41.

Reeks, Trenham, Esq.
On professors' salaries at Royal School of Mines, *Rep.* V. *App.*, p. 38

Register Office.
Estimate for reports for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Registrar-General.
Meteorological observations supplied to, *Rep.* VIII., p. 20, 26.

Religion.
As affecting King's College and Catholic University of Ireland, *Rep.* V., p. 8, 25, 26.
Not recognized for degrees, &c. at Queen's University, Ireland, *Rep.* VII., p. 35.

Revised Code.
Codes of 1861 and 1871, as affecting scientific instruction, *Rep.* II., p. xi.–xix.

Richards, Admiral.
On scientific advice for Government, *Rep.* VIII., p. 3.
On physical observatories, *Rep.* VIII., p. 14.
On a minister and council of science, *Rep.* VIII., p. 31.
On a council of science as affecting Admiralty, *Rep.* VIII., p. 31.

Rigg, Rev. Dr.
On scientific instruction in colleges and schools, *Rep.* II., p. xii.–xiv.

Robson, Mr.
On University College and Hospital, *Rep.* V., p. 4, 6, 7, 11; *App.* p. 29.

Rolleston, Dr.
On an electing board for professors, *Rep.* III., p. xxxii.
On biology at Oxford, *Rep.* III. *App.*, p. lxi.
On early instruction in science, *Rep.* VI., p. 7.

Roscoe, Professor.
On science in German universities, *Rep.* III., p. xxvi.
On study at Owens College, *Rep.* V., p. 18, 19.
On a council of science, *Rep.* VIII., p. 32, 40.

Rossall School.
Scientific instruction in, *Rep.* VI. *App.*, p. 17, 61, 97, 134.

Rosse, Lord.
On Royal Society Government Grant, *Rep.* VIII., p. 6.

Royal College of Chemistry.
Organization, instruction, &c. in, *Rep.* I., p. vii.; *Rep.* II., p. xxi.

Royal College of Science, Dublin.
Exhibitions to, collections of, &c., *Rep.* II., p. xxiii.; *Rep.* IV., p. 15.

Royal College of Surgeons.
Hunterian Museum of, &c., *Rep.* IV., p. 4, 23.

Royal Dublin Society.
Museums administered by, *Rep.* IV., p. 15.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 26.

Royal Geographical Society.
Government grant to, *Rep.* VIII., p. 6.

Royal Irish Academy.
Estimates for, in 1873–4, *Rep.* IV. *App.*, p. 26.

Royal School of Mines.
Relation of, to Geological Survey, *Rep.* I., p. vii.
Want of a chair of mathematics, laboratories, &c. in, *Rep.* I., p. vii.
Want of accommodation in, *Rep.* I., p. vii.
Exhibitions to, *Rep.* II., p. xxiii.
Professorial stipends at, *Rep.* V., p. 11; *App.* p. 38.

Royal School of Naval Architecture.
In relation to new Science School at South Kensington, *Rep.* I., p. viii.

Royal Society.
Government Grant administered by, *Rep.* VIII., p. 6, 21.
As managers of Meteorological Office, *Rep.* VIII., p. 17.
State council of science proposed by, *Rep.* VIII., p. 29.
As scientific adviser of Government, *Rep.* VIII., p. 41.

Royal Society of Edinburgh.
Memorial from, for a Government grant, *Rep.* VIII. p. 22.

Rugby School.
Scientific instruction, museum, &c. in, *Rep.* VI., p. 5; *App.* p. 16–61, 105, 158.
Temple Observatory at, *Rep.* VI. *App.*, p. 43.

Russell, Earl.
On Government grant to Royal Society, *Rep.* VIII., p. 6.

S.

Saint Andrew's University.
Colleges, chairs, funds, teaching, &c., *Rep.* VII., p. 4, 5, 22.
Connexion of classes at Dundee with, *Rep.* VII., p. 25.
Salaries in, and estimates for, &c., *Rep.* VII. *App.*, p. 44, 70–72.

Saint Paul's School.
No science in curriculum of, *Rep.* VI. *App.*, p. 128.

Saint Peter's College, Westminster.
Scientific instruction in, *Rep.* VI. *App.*, p. 16–54, 94, 130.

Salaries.
See INCOME AND EXPENDITURE.

Sabine, Sir Edward.
On Royal Society Government Grant, *Rep.* VIII., p. 7.
On a council of science, *Rep.* VIII., p. 29.
On Royal Society as advisers of Government, *Rep.* VIII., p. 45.

Salisbury, The Most Hon. R. A., Marquess of.
On unsatisfactory application of revenues of fellowships, *Rep.* III., p. xliv.
On scientific instruction for instrument makers, *Rep.* IV. p. 13.
On State aid to science and scientific investigators, *Rep.* III., p. xlvi; *Rep.* VIII., p. 8, 22–24.
On extension of Royal Society government grant, *Rep.* VIII., p. 13, 22.
On multiplying physical observatories, *Rep.* VIII., p. 13.
Objection by, to a council of science, *Rep.* VIII., p. 43.

Sanderson, Dr. Burdon.
On State aid to existing laboratories, *Rep.* VIII., p. 12.

Scholarships and Exhibitions.
To Royal School of Mines, and College of Science, Dublin, *Rep.* II., p. xxiii.
At Oxford and Cambridge, *Rep.* III., p. xiii., xliii.
None, exclusively for science, at University College, *Rep.* V., p. 4.
At Newcastle College of Physical Science, *Rep.* V., p. 23.
At Catholic University of Ireland, *Rep.* V., p. 26.
At Clifton, Rugby, Marlborough, &c., *Rep.* VI. *App.*, p. 54.
Bursaries at Glasgow University, *Rep.* VII., p. 17.
Large number of, at Aberdeen University, *Rep.* VII., p. 27.
At Dublin University, *Rep.* VII., p. 29–31.
Should be assigned for science at Trinity College, Dublin, *Rep.* VII., p. 34.
In Queen's Colleges, Ireland, *Rep.* VII., p. 36.
At London University, *Rep.* VII. *App.*, p. 43.

School Boards.
Scientific teaching for schools under, *Rep.* II., p. xvii.

School Scientific Societies.
At Rugby, Marlborough, Winchester, &c., *Rep.* VI. *App.*, p. 49–53.

Schools, Elementary.
Scientific instruction in, *Rep.* II., p. xi.; *Rep.* VI., p. 7.
For Catholics, in Ireland, *Rep.* V., p. 28.
Expenses of teaching of science in, *Rep.* VI. *App.*, p. 57.

Schools, Public and Endowed.
University matriculation examination as affecting, *Rep.* III., p. viii.
University "leaving" examination for, *Rep.* III., p. ix.
Science and teachers of science in, *Rep.* III., p. liv.; *Rep.* VI., p. 1–10; *App.* p. 14–255.
Laboratories in, *Rep.* VI. *App.*, p. 36.
How universities can best aid, *Rep.* VI. *App.*, p. 60.
Returns from head-masters respecting, *Rep.* VI. *App.*, p. 207–255.

Schools Inquiry Commission, 1864.
On importance of teaching science in schools, *Rep.* V., p. 3.

Science.
Taught under Department of Science and Art, *Rep.* II., p. xxii.
Meaning of, as employed by the Commission, *Rep.* III., p. vii.
In connexion with literary culture, *Rep.* III., p. x.
Want of University scholarships in, *Rep.* III., p. xiii.
Aid to, in France, *Rep.* IV. *App.*, p. 32.
Teaching of, in public schools, *Rep.* VI., p. 1–10; *App.*, p. 14–255.
Knowledge essential before study of, *Rep.* VI. *App.*, p. 54.
In school training, *Rep.* VI., p. 1.; *App.* p. 55.
Relations of Government to, *Rep.* VIII., p. 1.
Applications of, in association with teaching, *Rep.* VII., p. 18.

Science Classes.
Under Science and Art Department, *Rep.* II., p. xix.
In East Lancashire, *Rep.* II., p. xxvii.

Science Programmes.
By Professor Frankland, &c., *Rep.* VI. *App.*, p. 62, 85–93.

Science School at South Kensington.
Royal School of Mines and College of Chemistry to be consolidated with, *Rep.* I., p. vii.
A dean and council of professors for, *Rep.* I., p. vii.
Practical instruction of science teachers to be given in, *Rep.* I., p. vii.
Organization of, and accommodation for, *Rep.* I. *Supp.*, p. ix.

Science and Art Department.
New Science School under, at South Kensington, *Rep.* I. *Supp.*, p. ix.
Advantage of, to training colleges, &c., *Rep.* II., p. xiv.
Constitution of, *Rep.* II., p. xix.
Science classes, subjects, and teachers under, *Rep.* II., p. xix.–xxii.
Buildings and apparatus under, *Rep.* II., p. xxii.
Payments on results under, *Rep.* II., p. xxv.
Examinations under, *Rep.* II., p. xxii.
Ages of candidates under, *Rep.* II., p. xxiv.
Inspection under, *Rep.* II., p. xxv.
Might organize typical museums, *Rep.* IV., p. 17.
See SOUTH KENSINGTON MUSEUM.

Scientific Instrument Makers.
Scientific instruction for, *Rep.* IV., p. 13.

Scientific Research.
See ORIGINAL RESEARCH.

Scientific Societies.
Extension of research by grants to, *Rep.* VIII., p. 23.
In connexion with public schools, *Rep.* VI. *App.*, p. 49–53.

Scientific Workers.
Remuneration of, *Rep.* VIII., p. 22, 26.

Sclater, Dr.
On lectures in British Museum, *Rep.* IV., p. 18.
On a minister and council of science, *Rep.* VIII., p. 28, 32.

Scotland.
Universities of, *Rep.* VII., p. 4; *App.* p. 44.
Objection to increase of degree-giving bodies in, *Rep.* VII., p. 22.
Should share in one grant for science, *Rep.* VIII., p. 22.

Scott, Mr. R. H.
On Meteorological Office and Meteorological Society, &c., *Rep.* VIII., p. 20.

Scottish Meteorological Society.
Co-operation of, with Meteorological Office, *Rep.* VIII., p. 20.
Importance of returns of, *Rep.* VIII., p. 26.

Ships.
See Navy.

Shore, Mr.
On early instruction in science, *Rep.* VI., p. 7.

Shrewsbury School.
No special scientific class in, *Rep.* VI. *App.*, p. 94.

Siemens, Dr.
On State promotion of science by observatories and grants to societies, *Rep.* VIII., p. 12, 14, 23.
On a council of science, *Rep.* VIII., p. 37, 40.

Smith, Professor H.
On an electing board for professors, *Rep.* III., p. xxxii.

South Kensington.
Proposed new Science School at, *Rep.* I., p. vii.; *Rep.* I. *Supp.*, p. ix.

South Kensington Museum.
No competition between, and Kew, *Rep.* IV., p. 8.
Its scientific collections, want of physical and mechanical instruments, &c., *Rep.* IV., p. 11–14.
Proposed lectures in, *Rep.* IV., p. 20–24.
See Science and Art Department.

Spottiswoode, Mr.
On attaching physical observatories to existing ones, *Rep.* VIII., p. 14.
On increasing Government grant to Royal Society, *Rep.* VIII., p. 22.
On a council of science, *Rep.* VIII., p. 34.

Standards Department.
As administered under Government, *Rep.* VIII., p. 1, 5.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 50.

Statistical Department, Board of Trade.
Mining Record Office proposed to be lodged with, *Rep.* I., p. vii.

Stewart, Dr. Balfour.
On a State observatory for astronomical physics, *Rep.* VIII., p. 16.
On a director for meteorology, *Rep.* VIII, p. 19.
On aiding scientific workers, *Rep.* VIII., p. 23.
On ministry and council of science, *Rep.* VIII., p. 28, 32.

Stonyhurst College.
Scientific teaching in, *Rep.* VI. *App.*, p. 141.

Strachey, General.
On scientific advice for Government, *Rep.* VIII., p. 3.
On meteorology and the Meteorological Committee, *Rep.* VIII., p. 17, 18.
On a minister and council of science, *Rep.* VIII. p. 28, 35.

Strange, Colonel.
On a museum of scientific instruments, *Rep.* IV., p. 14.
On want of State observatories and laboratories, *Rep.* VIII., p. 9.
Questions by, relating to astronomical physics, *Rep.* VIII., p. 15.
On a minister and council of science, *Rep.* VIII., p. 28, 30.

Students.
See King's College, &c.

Sullivan, Professor.
On Irish schools, *Rep.* V., p. 28.

T.

Taunton College School.
Scientific instruction in, *Rep.* VI. *App.*, p. 17–61, 95, 175, 199.

Teachers in Universities.
Plurality of, indispensable, *Rep.* III., p. xxvi.

Teachers of Science.
Instruction of, in London, *Rep.* I., p. viii.; *Rep.* I. *Supp.*, p. ix.; *Rep.* II., p. xxi.
Under Science and Art Department, *Rep.* II., p. xx.
Demand for, in schools, *Rep.* III., p. liv.; *Rep.* V., p. 28; *Rep.* VI., p. 5, 58.
Value of a museum of scientific apparatus to, *Rep.* IV., p. 13.

Technical Chemistry.
At Andersonian Institution, *Rep.* VII., p. 21.

Technical Education.
Relation of universities to, *Rep.* III., p. liv.

Text Books.
In colleges and schools, *Rep.* VI. *App.*, p. 25.

Thomson, Professor Allen.
On degrees, &c. at Glasgow University, *Rep.* VII., p. 15, 20.

Thomson, Sir Wm.
On examinations as detrimental to research, *Rep.* III., p. lviii.
On early instruction in science, *Rep.* VI., p. 6.
On Glasgow University, *Rep.* VII., p. 20.
On a minister and council of science, *Rep.* VIII., p. 3, 27, 39.
On experiments for Standards Department, *Rep.* VIII., p. 5.
On State aid to research, *Rep.* VIII., p. 8, 22.
On multiplying laboratories and observatories, *Rep.* VIII., p. 9, 14, 15.
On promotion of observations on tides, *Rep.* VIII., p. 21.

Tides.
Observations on, *Rep.* VIII., p. 20, 26.

Time Tables.
In public schools, *Rep.* VI. *App.*, p. 109–197.

Topographical Survey.
As a department of Government, *Rep.* VIII., p. 1.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Training Colleges.
Scientific instruction in, *Rep.* II., p. xi.

Trinity College.
See Dublin University.

Trustees of British Museum.
Objection to, *Rep.* IV., p. 3.

Tuckwell, Rev. W.
On scientific teaching in schools, *Rep.* VI. *App.*, p. 57, 66, 73, 75.

U.

University College, London.
History, administration, faculties, &c. of, *Rep.* V., p. 1; *App.* p. 29.
Memorial from, respecting Indian appointments, *Rep.* V., p. 11.

University College Hospital.
Connexion of College with, *Rep.* V., p. 4.

University College School.
Scientific instruction in, &c. in, *Rep.* V., p. 3; *Rep.* VI. *App.*, p. 16–57, 111, 161, 203.

Universities.
Proposals for reform of, *Rep.* III. *App.*, p. lxiv.
How they can aid science teaching, *Rep.* VI. *App.*, p. 60.

Universities of Oxford and Cambridge.
Courses of study and examinations, *Rep.* III., p. viii.
The professoriate, p. xv.
Scientific institutions within them, p. xxxviii.
The colleges, p. xliii.
Organization of college, in relation to university, instruction, p. l.
Relation to technical education, p. liv.
Duty in regard to advancement of science, p. lvi.
See also Cambridge University *and* Oxford University

Universities of Scotland.
Papers relating to, *Rep.* VII. *App.*, p. 44.
See Edinburgh University, &c.

Universities' Commission.
On examination of students proposing to enter universities, *Rep.* VI. *App.*, p. 61.

Universities (Scotland) Act.
Report of Commissioners under, *Rep.* VII., p. 4.

W.

Waterhouse, Mr.
On lectures by museum keepers, *Rep.* IV., p. 18.

Wellington College.
Scientific instruction in, *Rep.* VI. *App.*, p. 17–61, 109, 144.

Wesleyan Training College, Westminster.
Scientific instruction in, *Rep.* II., p. xii.–xiv.

Williamson, Professor.
On Birkbeck Chemical Laboratory, *Rep.* V., p. 6.
Objection of, to laboratories for research only, *Rep.* VIII., p. 12.
On a council of science, *Rep.* VIII., p. 40.

Wilson, Mr.
On science teaching in schools, *Rep.* VI., p. 3, 4; *App.*, p. 55, 56, 59, 60, 63.

Winchester College.
Scientific instruction in, *Rep.* VI., *App.*, p. 18–61, 95, 140.

Women.
Instruction of, at University College, *Rep.* V., p. 2.

Woodlock, Very Rev. Canon.
On religion, as affecting Catholic University of Ireland, *Rep.* V., p. 27.

Woolwich Division.
At Eton College, *Rep.* VI. *App.*, p. 186.

Woolwich Magnetic and Meteorological Department.
Estimates for, in 1874–5, *Rep.* VIII. *App.*, p. 49.

Working Men's College, Manchester.
Absorption of, in Owens College, *Rep.* V., p. 18.

Workshops.
Objection to, in colleges, *Rep.* V., p. 23.
At King's College, Clifton College, &c., *Rep.* VI. *App.*, p. 53, 178.

GENERAL INDEX

TO THE

EVIDENCE, THE APPENDICES TO THE EVIDENCE, AND THE ANALYSES OF THE EVIDENCE.

A.

Abbott's Ann.
  School at, 8303–8312.

Aberdeen, Lord.
  Department of Science and Art under, 2.
  Government of, recommended a science college, 5954.

Aberdeen University.
  Professors, bursaries, &c. at, 5683, 9566, 9729–9733.

Academies of Science, Paid.
  In Russia and France, 10,521, 10,035–11,038.
  Objection to them, 10,521, 10,540, 11,035–11,038.

Accidents in Mines.
  Less with skilled workmen, 1969.

Accommodation for Science Purposes.
  At Jermyn Street Institution, 400–417, 519, 538, 549, 667–678, 695, 2472–2492, 5690–5693, 5732–5734, 5985–5991, 6108, 6478–6480.
  At Plymouth Science School, 2064.
  At Glasgow University, 2653–2655, 9513, 9824–9841, 9857, 9929–9933.
  At Oxford University, 2879–2999, 3215–3217, 3477, 3478, 3583, 3590, 3707, 3708, 3787, 3896, 3965, 4080, 4158, 4859.
  At Cambridge University, 4234–4240, 4361, 4365–4399, 4410–4422, 4436, 4478–4482, 4664, 4694–4715, 4740–4745, 4764–4766, 4794–4812, 4955, 4972–4975, 4996, 5041, 5108, 5167, 5354, 5363, 5472, 5551, 5584, 5596.
  At Bristol Trade School, 6333.
  At British Museum, 6592–6640, 6830, 7463, 10,118, 10,124.
  At Kew Museum, 6662–6664, 6680.
  At King's College, 6886–6889, 7023, 7027.
  At University College, 7132, 7134, 7799–7803, 7823.
  At Owens' College, 7265, 7369–7406.
  At Berlin, Bonn, Leipzig, &c., 7384–7406, 10,114.
  At South Kensington, 7441–7447, 13,833, 13,839, 13,847.
  At Newcastle College of Physical Science, 8759, 8819, 9193, 9216.
  At Edinburgh University, 9278–9313, 9355–9369, 9378, 9388, 9408, 9416–9419, 9466–9470, 9497–9501, 10,203–10,206.
  At Edinburgh Science and Art Museum, 9483–9487.
  At St. Andrew's University, 9662–9701, 9714–9719, 9765, 9766, 9786.
  At Anderson's University, Glasgow, 9961, 9984, 10,045.
  At Burlington House, 10,443–10,476, 11,119, 12,598–12,600.
  For State laboratories, &c., 10,892, 11,354, 11,497–11,502, 12,127–12,134, 13,054–13,118.
  At Royal Society of Edinburgh, 12,467, 12,493.
  For Royal Geographical Society, 12,592–12,598.
  At Dublin University, 12,763–12,775, 12,787–12,791.
  At Queen's College, Belfast, 13,281–13,289.
  At Catholic University of Ireland, 13,370–13,385, 13,490.
  At Oxford Botanic Garden, 13,754–13,810.
  For Patent Museum, &c., 13,847.
  At Meteorological Office, 13,886, 14,011–14,014, 14,393–14,398, 14,483.

Acland, Henry W., Esq., M.D.
  Evidence of, 2874–2977. Analysis of Evidence, Vol. II. App. page *75*.

Acts of Parliament. See *Parliament*.

Adams, J. C., Esq., M.A.
  Evidence of, 4304–4355. Analysis of Evidence, Vol. II. App. page *109*.

Adams, W. G., Esq., M.A.
  Evidence of, 6876–7002. Analysis of Evidence, Vol. II. App. page *154*.

Admiralty.
  Dockyard schools under, 884–1168.
  Admiralty and Patent Museum, 9136–9141.
  Schools and students, 1026–1055, 1163.
  Greenwich Observatory under, 10,524–10,528.
  Scientific investigation by, 11,289–11,300, 11,317, 11,334, 11,343, 11,597–11,599, 11,633–11,637, 12,706–12,723.
  If under a council for science, 11,582–11,592, 12,256, 12,563.
  Meteorological Office consulted by, 13,948.

Admiralty Surveys. See *Survey Expeditions*.

Advancement of Science.
  Papers on the, by George Gore, App. X., Vol. II., pp. *33–41*.

Agassiz, Professor.
  Natural history museum on plan of, 6597.

Age of Science Students, &c.
  Children learning science, &c., 315–319, 348–350, 1664, 1729, 1740, 1943, 2276, 2781, 3094–3096, 3659–696, 3740, 4603, 4896, 6123–6125, 6196–6198, 6346–6420, 7146–7148, 7771–7773, 7982, 8060, 8091, 8144–8148, 8241, 8297, 8313–8318, 8326, 8400–8405, 8420–8433, 8484, 8529, 8619, 8729–8732, 8741, 8922–8930, 13,480.
  Science and Art Department candidates, 348, 4896, 6460, 6471–6475.
  At School of Mines, 380.
  At School of Naval Architecture, 882, 998, 1136.
  In dockyard schools, 1015.
  At the École Chaptal, 1729.
  Of students of science generally, 1740, 2155, 2274, 3639, 3918, 4137, 4848, 7702, 7869, 9242.
  Mining students, 2536.
  At Oxford University, 3426.
  At Cambridge University, 4585, 4586, 4603, 4604.
  Candidates for Woolwich, 4609.
  Civil engineering students, 5209.
  In German polytechnic schools, 5217.
  Candidates for Indian Civil Service, 5232, 5234.
  At King's College, 6929, 7619.
  At University College School, 7124, 7125.
  At Yorkshire Board of Education, 6113–6125, 6196–6198.
  At Bristol Trade School, 6346, 6361–6380, 6420.
  At Owens' College, 7251, 7359, 7411.
  In German universities, 7389.
  At London University matriculation, 7867.
  At St. Mark's College, 7904.
  In training colleges, 8233, 8238, 8239.
  At Wesleyan Training College, 8041, 8042.
  In American schools, 8297, 8326, 8327.
  In the Black Country evening schools, 8484.
  At Newcastle College of Science, 8764.
  In Birkbeck schools, 8729.
  At Society of Arts' examinations, 9002.
  For Edinburgh University Hope Scholarships, 9385.
  At Glasgow University, 9506, 9872–9881.
  At St. Andrew's University, 9620, 9706–9713, 9787.
  At Anderson's University, 10,036.
  At Queen's College, Galway, 13,147.
  At Queen's College, Cork, 13,225.
  At Catholic University of Ireland, 13,435, 13,436.
  In Irish secondary schools, 13,480.

Agricultural Colleges.
  At Cirencester, in America, &c., 1360, 1434, 1449–1452, 1535–1540.

Agricultural Department (Washington).
  Reports on forest trees, &c., 1422, 1536.

Agriculture.
  Importance of chemistry, &c. to, 464–469, 754, 8469.
  Science teaching in rural schools, 8293–8295.

AGRICULTURE—*cont.*
- Scientific instruction bearing on, 8469, 9204, 9255, 9260, 12,460.
- Agriculturists have encouraged Newcastle College of Science, 9260.
- Chair of, in Edinburgh University, 9276, 9373.
- Analyses of soils, &c. in Glasgow University, 9835–9839.
- Mr. Bennet Lawes' endowment, 11,575.
- Meteorology in reference to, 12,503–12,509, 12,528–12,530.
- German and French institutions for, 12,530–12,533.
- Government farms in Ireland, 12,532.

AIRY, G.B., Sir, K.C.B.
- Evidence of, 10,477–10,566. Analysis of Evidence, Vol. II. page *191*.
- Impulse to study of physics given by, 4232, 4284, 4324.
- On the (now abolished) Board of Longitude, App. VIII., Vol. II., pp. *31*, *32*.

AIX-LA-CHAPELLE.
- Polytechnic school at, 1836–1841, 10,825–10,836, 10,845.

ALAIS (FRANCE).
- Mining school at, 2377.

ALDRICHIAN PROFESSORSHIP (OXFORD).
- Comprised in Linacre professorship, 3210–3213, 3385.

ALGEBRA.
- Not recognized in Education Department syllabus, 8035.

ALKALI WORKS.
- Controlled by Board of Trade, 12,623–12,631.

ALL SOULS' COLLEGE (OXFORD).
- Has no students, except a Bible clerk or two, 3667.

AMERICA.
- Scientific work of Congress, 1407, 1411–1474, 1509, 1525–1544, 1566–1570.
- Multiplying degrees in, 7351.
- Text-books in, 8337, 8340.
- Superficial information in, 8338, 8339.
- Investigations of iron in, 10,971.
- Observatory for solar research in, 11,364, 11,476, 11,528.
- Weights and measures of, 11,656.
- Meteorology in, 14,227, 14,444–14,470.
- International meteorology proposed by, 14,319.
- No national scholarships for science in, 1435–1437, 1444.
- State aid in, for original research, &c., 1438–1448, 1461–1465, 1542–1544.
- Amount expended on science by, 1445, 1446.
- Universities and scientific societies in, 1447, 1448, 1470–1474.
- Scientific instruction at Harvard and Cornell Universities 1458–1460.
- Coast surveys in, 1461–1464.
- Professors, like those of France, desirable in, 1507–1509.
- Physical observations, &c. in, 1517–1520.
- Agricultural Department at Washington, 1422, 1535.
- Education in, 1539.
- Employment for engineers, chemists, &c. in, 1555–1559.
- Americans go to Germany to study science, 1557.

AMERICAN SCHOOLS.
- Primary schools and inspectors, 1428–1434, 1541, 1563–1565, 8325–8327.
- Higher schools, agricultural colleges, &c., 1434, 1449–1452, 1536–1539.
- Schools, and Minister of Education in, 1453, 1454.
- System of graded schools, 1456.
- Schools endowed by individuals in, 1560–1562.
- No compulsion in, 8297, 8298.
- Too many subjects taught in, 8299, 8320.
- Science teaching in, has had a bad effect, 8320–8323.
- Secondary schools in, 8325.
- Passage from elementary to higher schools in, 8341.
- Energy of American teachers, 8357.

ANALYSIS OF TEACHERS OF SCIENCE CLASSES.
- In connexion with the Science and Art Department, 1869–70, App., XII., vol. I., p. *41*.

ANATOMY.
- At Oxford University, 3210–3213, 3238–3240, 3709, 4149–4165, 4191, 4214.
- At Cambridge University, 4386, 4408–4423, 4453, 4655, 4702–4715, 4735–4807, 5042, 5108, 5157, 5314, 5354.
- At Hunterian Museum, 6590, 6853.
- Too much divorced from zoology, 6852.
- At South Kensington new natural-history museum, 6853.

ANATOMY—*cont.*
- At Edinburgh University, 9264–9328, 9416–9419, 9500.
- At St. Andrew's University, 9788.
- At Glasgow University, 9791–9933.
- Veterinary institutions for the study of, 9800.
- At Anderson's University, 9958–9962.
- At Dublin University, 12,897–12,935.

ANDERSON, J., ESQ., LL.D.
- Evidence of, 11,918–11,969. Analysis of Evidence, Vol. II. App. page *200*.
- Paper handed in by, App. XII., Vol. II., pp. *62*–*64*.

ANDERSONIAN INSTITUTION (GLASGOW).
- Promotion of science at, 2802–2806, 9934–9989, 10,020–10,070.

ANILINE COLOURS.
- Discovered by students of College of Chemistry, 5682, 5683.

ANIMAL PHYSIOLOGY.
- Should be taught in elementary schools, 5922.

APPARATUS FOR SCIENCE PURPOSES.
- State aid should be applied to, 240.
- At Royal School of Mines, 488, 489.
- Professors should be assisted with, 1229.
- Given by Smithsonian Institution, 1407, 1466–1469, 1517–1520.
- In science schools at Boston, New York, &c., 1519.
- At Glasgow University, 2765–2772, 9511–9514, 9773, 9825, 9902–9909.
- Typical illustrations for schools, 2966–2970.
- At Oxford University, 2984–2996, 3280–3283, 3304–3308, 3477, 3543–3556, 3583, 3595, 3890, 3896, 4859, 4165.
- Specimen cases in museums, 3107, 3108.
- At Cambridge University, 4234, 4243, 4360, 4395–4400, 4361, 4554–4556, 4629, 4653, 4659, 4670–4698, 4996, 5068–5070, 5108, 5472.
- At Hyde Institute, Oxford, 4158, 4165.
- Government repository for, 5211.
- Students should be taught to handle, 5260, 9511.
- In institutions under East Lancashire Union, 2154.
- For chemistry, physics, &c., 5906–5908, 5921.
- Given by Science and Art Department, 6104, 6107, 2154.
- Deficiency of, in science classes formerly, 6129–6134.
- In Bristol Trade School, 6331, 6332.
- At King's College, 6886–6889, 6967, 7039, 7639–7641.
- At University College and School, 7134, 7152–7159, 7165, 7178, 7799, 7804, 7836, 7839, 7844–7848.
- At St. Mark's College, 7939–7942.
- Necessity for, in training colleges, 8067.
- Difficulty in supplying schools with, 8317.
- In Black Country elementary schools, 8523–8525.
- At Newcastle College of Science, 8760.
- No grant for classes deficient in, 8959–8966, 8988.
- At Huddersfield Mechanics' Institute, 8982.
- For elementary schools, 8987.
- In mechanics' institutes before 1852, 9017–9027.
- At Edinburgh University, 9264, 9301, 9312, 9334, 9349–9354, 9360–9363, 9371, 9372, 9467–9481, 9491, 9773.
- At St. Andrew's University, 9643, 9675–9701, 9715–9761, 9772–9780.
- Want of, in Scotland, 9770, 9771.
- At Aberdeen University, &c., 9773.
- At Anderson's University, 9962.
- Of Standards' Department, 10,381–10,416, 11,720–11,735, 11,752, 11,790.
- Accuracy of thermometers, &c., 10,433, 10,634–10,638.
- Museum of, desirable, 10,434–10,442, 10,495.
- Instruction of makers of, 10,494, 13,575.
- Of Admiralty and Greenwich Observatory, 10,527, 11,455.
- For research in universities, 10,532–10,537.
- Exhibition of, 10,578, 10,586–10,589, 10,668–10,670.
- State aid for, 10,607–10,633, 11,354, 12,302–12,305, 12,322.
- For a State physical laboratory, 10,702–10,714, 11,300.
- At Kew and Greenwich Observatories, 11,455.
- For teaching weights and measures in France and Germany, 11,656.
- Of Scottish Meteorological Society, 12,368–12,370, 12,392, 12,412, 12,517–12,521.
- Arrangement of, by Meteorological Committee and Scottish Meteorological Society, 12,412.
- Royal Society's grant applied to, 12,499.
- Teaching use of, by Royal Geographical Society, 12,603.
- At Queen's College, Cork, 13,201, 13,226, 13,237.
- At Queen's College, Belfast, 13,307, 13,308, 13,332, 13,342, 13,357–13,360.
- At Catholic University of Ireland, 13,488–13,490.
- At South Kensington Museum, 13,833–13,838.

Applegarth, Mr. Robert.
  Evidence of, 1937–2046. Analysis of Evidence, Vol. I. App. page *92*.

Application du Génie Maritime.
  School of, in France, 954–956.

Applied Mechanics.
  At School of Mines, &c., 365, 5953, 7170.
    See *Mechanics*.

Appointments.
  At Queen's College, Cork, 13,232.
  Of scientific men, for research, 13,567–13,570, 13,591–13,593, 13,609–13,611, 13,617–13,619.
  At British Museum, 13,605.
  At Oxford University, 13,721–13,726.

Apprenticeship.
  Of engineers, science teachers, &c., 1580, 1584, 1601, 1604, 1687–1692, 1975–2044, 2335, 2424–2427, 8844–8853, 8905–8907, 8915, 8931–8940.

pppropriations in Aid of Science, Literature, &c.
  Made by the United States Congress, in 1869–70 for the ensuing year, App. I., Vol. II., p. *1*.

Architects.
  Scientific instruction for, 9470.

Architectural Drawing.
  Teaching of, 6082.

Architecture.
  Teaching of, at Cambridge University, 4395, 4673–4676.
  Teaching of, at King's College, 7092.

Archæology.
  Interest taken by Cambridge students in, 4674.

Arithmetic.
  Imperfection of books of, 11,656.
  Importance of teaching, 5922.
  In University College School, 7146.

Armstrong, Sir W. G., C.B.
  Evidence of, 9202–9261. Analysis of Evidence, Vol. 1. App. page *148*.

Army.
  Heads of scientific branches of, might be members of a council for science, 12,046, 12,086.

Army Medical Department.
  In conjunction with Meteorological Office, 13,950.

Arnott, Dr. Neil,
  Promotion of physical science by, 322, 2661.

Art.
  Promotion of, by Smithsonian Institution, 1407.
    See *Drawing*.

Articled Pupils.
  In engineering establishments, &c., 1072–1074, 1089, 1090, 1099–1101.

Artizans.
  Scientific instruction for, 2, 171, 233, 5954, 5960.
  Lectures for, at Royal School of Mines, 533, 558–565, 725, 2472, 5705–5713.
  Self-instructed, 629.
  Need of mechanical drawing felt by, 1615, 1704–1706.
  Watt Institution for, in Edinburgh, 1630, 1633–1644.
  Teaching of managers more important than, 1701–1707, 1784.
  Better education for, desirable, 1784–1787.
  Schools in Oldham for, 1806–1809, 1814, 1904, 1934.
  Sent to India, 1830, 1831.
  Difficulty of getting them to attend science classes, 1878.
  Late study of science by, 1953, 1958.
  Desire of, to acquire technical science, 1956–1960.
  In England, have little opportunity of becoming skilled, 1970, 1971.
  Diversity of intelligence amongst, 1999–2004.
  Not sufficiently assisted by employers, 2005, 2302, 2042–2045.
  Better treated abroad than in England, 2011, 2012.
  Benefits derived by, from science classes, 2228–2230.
  Contributions of, to educational institutions, 2239.
  Science schools should correspond to requirements of, 2376–2379.
  No instruction given to, in Glasgow University, 2726–2731.
  Establishing science schools for, 2791–2795.
  Science classes for, at Andersonian University, 2802–2806, 9966–9978.
  Attend classes to study principles of science, 2804–2806.

Artizans—*cont.*
  Do not attend museums, 6218.
  Professor Huxley's "Physiology" for, 6264–6266.
  Science classes in Bradford not attended by, 6298–6300.
  Payment on results should not be confined to, 6311, 6312.
  In Bristol Trade School, 6381–6387.
  "Artizans" according to Science and Art Department, 6382.
  Payments to teachers of science to, 6445–6456.
  Lectures given to, at British Museum, 6501, 6505, 6506, 6595–6597, 7771, 10,119–10,123.
  Scientific education for, in Manchester, 7251–7300, 7431.
  Exhibitions held by, 7283, 7287, 7348–7350, 7409.
  In Owens College, 7294, 7411.
  Difficult to instruct, 7394.
  Demand for science instruction by, 6144, 7408.
  Cheap course for, desirable at King's College, 7649–7656.
  Mechanics' institutes for teaching science to, 8866, 8867.
  Fees paid by, at Huddersfield Mechanics' Institution, 8880, 8986.
  At technical classes in Yorkshire, 8901, 8994, 8995.
  Might devise improvements in mechanical, not in chemical, operations, 9169, 9170.
  Universities should give scientific instruction to, 9434.
  Do not attend scientific teaching in Glasgow, 9593, 9609.
  Evening science classes for, at Dundee, 9647.
  At St. Andrew's University, 9713, 9745, 9754–9756.
  Evening lectures on science desirable for, 9811.
  Science examination papers by ploughmen, 11,963–11,969.
  Scientific knowledge of, in Scotland, 12,423–12,428.
  Edinburgh Geological Society is largely composed of, 12,535–12,538.

Artizans (Foreign).
  Employment of, in England, formerly, 1826, 1842.
  Power of, to make drawings of machinery, 1969.
  Industrial school of Belgian miners, 1970.
  Competition of, with English, 1970, 1971, 2011.
  Scientific knowledge of, in Switzerland, 2010.

Art Schools.
  At Oldham, 1896.
  Mechanical drawing should be taught in, 1620–1629.
  Number of, personally inspected, 5923, 5924.
  Masters in, 5979.
  Pupils of, 6009, 6020.

Art Teachers.
  Fees of, &c., 5954, 6075.
  Practice of Education Department as to payment of, 6089.

Art Training School.
  Experience gained in an, useful in a training school for science teachers, 44.

Arts.
  Objection to teaching arts or manufactures, 7367.
  At Edinburgh University, 9276.
  At Glasgow University, 9529, 9578, 9597, 9859, 9923.
  At St. Andrew's University, 9627, 9628, 9702, 9711.
  Science neglected in Scottish arts degrees, 9858, 9865.
  At Dublin University, 12,841, 12,880, 12,852, 12,887.
  At Queen's College, Galway, 13,177, 13,186.

Assaying.
  Taught correctly in technical schools, 1297.

Assessment for Science Purposes.
  On mining property, wages, &c., 2449–2466, 2619–2623, 2648–2650.

Assistant Professors, Demonstrators, &c.
  Extra-professors, "privat-docenten," and "répétiteurs," in continental universities, 1268, 1554, 2941–2943 7846
  Essential for proper science teaching, 2828–2832.
  At Oxford University, 2932–2935, 2941–2946, 2988, 3087, 3171, 3183 3238–3283, 3344–3498, 3546, 3557, 3618, 3807–4180, 4878, 13,668–13,752.
  At Cambridge University, 4235, 4242, 4291, 4365, 4395, 4405, 4417, 4457–4459, 4465, 4539–4549, 4649, 4650, 4671, 4708, 4714, 4776, 4791, 4807–4809, 4813, 4814, 4955, 4959, 5044, 5048, 5072–5099, 5108, 5129, 5131, 5151, 5167, 5171, 5189, 5196–5200, 5210, 5248–5266, 5277, 5336–5654.
  At King's College, 6883, 6958–6961.
  At University College, 7134, 7159, 7164, 7803–7806, 7845.
  At Newcastle College of Science, 8761.

ASSISTANT PROFESSORS, &c.—*cont.*
At Edinburgh University, 9265–9268, 9301–9317, 9337, 9338, 9347, 9358–9360, 9396, 9420–9424, 9437–9441, 9455, 9456.
At Glasgow University, 9513, 9576, 9600, 9796, 9824–9857.
At St. Andrew's University, 9619, 9676, 9689–9708, 9725–9737, 9768, 9780.
German method of selecting students as, 10,099.
At Dublin University, 12,916–12,920.
At Queen's College, Cork, 13,217–13,219.
At Queen's College, Belfast, 13,256, 13,281, 13,331, 13,340, 13,360.
None for science at the Catholic University of Ireland, 13,505.

ASSOCIATESHIPS.
At Royal School of Mines, 283.
At King's College, 7056, 7085.

ASTRONOMER ROYAL.
Lectures, &c. by, 1006, 11,656, 11,705.
Should not be charged with meteorology, 11,456, 11,526.
See AIRY, SIR G. B.

ASTRONOMY.
Aid to, by Smithsonian Institution, 1407, 1419.
Physical, for science schools, 2064, 2111.
At Oxford University, 3477, 3596, 3651–3653, 3771–3781.
At Cambridge University, 4236, 4306, 5166, 5271.
For primary school children, 4618–4628.
At King's College, 7629, 7630.
Observatory at Glasgow, 9902–9908.
At Greenwich; extension for solar physics, 10,315–10,441, 10,480–10,524, 11,456, 11,526, 11,990–11,993, 13,066–13,073, 13,121–13,124.
Systematic study of the sun, 10,316–10,328.
Kew photographic sun observations and spectroscopic observations, 10,318–10,320.
Public observatory for physics of astronomy desirable, 10,480–10,492.
Government has done too much in favour of, in proportion, 10,519, 10,520.
Observatories, expeditions, &c., wanted for, 10,572, 10,639–10,645.
Importance of astronomical physics; Government laboratory desirable, 10,681, 10,690, 10,697, 11,064–11,073, 11,599, 11,625–11,627, 12,279–12,283, 13,066–13,073, 13,121–13,124.
Want of system among workers in, 11,354–11,369, 11,525, 11,526.
Observatories for solar research in America, France, &c., 11,364, 11,476, 11,528.
Observations at Madras, 11,893.
At Glasgow University, 12,266–12,290.
A star catalogue should be undertaken by several observatories, 12,271–12,278.

ATHLETICS.
At Cambridge University, 4382, 4383.

ATKINSON, REV. E., D.D.
Evidence of, 5280–5308. Analysis of Evidence, Vol. II. App. page *126*.

AUSTRALIA.
Observatories for physical astronomy desirable in, 13,071.

AUSTRIA.
Mining schools of, 2325.
Metric system in, 11,656.
Trained natural history collectors in, 12,126.
Assessors on scientific subjects in, 12,355, 12,356.
Meteorological science in, 13,958–13,963, 14,020 (App. B.).

B.

BACHE, PROFESSOR.
Property left by, for original research, 1424.

BALL, JOHN, ESQ., M.A.
Evidence of, 7213–7238. Analysis of Evidence, Vol. II. App. page *138*.

BALLARAT MINING SCHOOL.
On Royal School of Mines' model, 2471.

BALLIOL COLLEGE (OXFORD).
Science teaching at, 3840, 3892, 3953, 4003, 4820–4843.

BANKS, SIR JOSEPH.
His collections at British Museum, 7739, 7759.

BARRY, REV. ALFRED, D.D.
Evidence of, 7079–7128. Analysis of Evidence, Vol. II. App. page *157*.

BATE, C. SPENCE, ESQ., F.R.S.
Evidence of, 2047–2135. Analysis of Evidence, Vol. I. App. page *93*.

BATESON, REV. W. H., D.D.
Evidence of, 4946–4993. Analysis of Evidence, Vol. II. App. page *118*.

BAVARIA.
Metric system in, 11,656.

BELFAST.
Natural history society, museum, &c. at, 10,309, 13,284, 13,285, 13,330.
See *Queen's College, Belfast. Scientific Societies.*

BELGIUM.
Scientific education of miners, &c. in, 2599, 2628–2645.
Mining accidents in, 2631–2638.
Ventilation system in, 2639–2645.
Mining system of, 8505.
Scientific men and science schools in, 9158.

BELL, I. LOWTHIAN, ESQ.
Evidence of, 9149–9201. Analysis of Evidence, Vol. I. App. page .
On a science school for Newcastle, 8757, 8795–8798, 8812.

BENTHAM, GEORGE, ESQ., F.R.S.
Evidence of, 7203–7212. Analysis of Evidence, Vol. II. App. page *137*.
On Kew and British Museum herbaria, &c., 7737–7740, 7745.

BERGAKADEMIE, FREIBERG.
Royal School of Mines compares favourably with, 543–545.

BERLIN.
Mining school at, 2325, 2456.
Scientific instruction in, 7384, 7385, 7389, 7391.
Botanic Garden of, 7757, 7758.
Chemical laboratory at, 47, 10,830–10,832.

BERLIN UNIVERSITY.
Introduction of science into, 7255.

BEST, HON. AND REV. SAMUEL.
Abbott's Ann School under, 8303, 8312.

BETHNAL GREEN MUSEUM.
Food and Animal Products' Collections at, 13,842.

BIOGRAPHY.
Importance of instruction in, 8531–8534, 8570.

BIOLOGY.
In proposed science college, 5953.
Professor and demonstrators for, 6000.
At Oxford University, 2874–2970, 3272, 3560, 3771–3781, 3810, 3817.
Meaning of the term, 2880, 3211.
Mr. Robertson's animal dissections, 2970.
Professorships of, should be multiplied, 3261.
At King's College, 7666–7669, 7689–7695.
Professorship of, for Newcastle College of Science, 8789–8792, 8838, 9153, 9155.
Combining professorships of, with geology and mineralogy, 8790.
At Glasgow University, 9867, 9868.
Government should aid researches in, 10,920–10,951.
Sea-captains, &c. should collect specimens illustrative of, 10,936–10,939.
Government laboratories for, 10,942–10,951, 11,064–11,073.

BIRKBECK SCHOOLS.
Social science, &c. taught in, 8725–8756.

BIRMINGHAM.
Institution like Owens College wanted in, 1667–1669.
Science teaching at Birmingham School, 4629, 4630.
Practical science school wanted at, 5109.
Desirable centre for instruction of science teachers, 8957.
Is inaugurating a museum of manufactures, 9148.
No provision in, for research, 10,885, 10,908–10,919.

BLACK BOARD.
Importance of, in teaching geology, 619.

BLEACHING.
Instruction in chemistry of, 8889–8891.

BOARDING-HOUSES FOR STUDENTS. See *Lodgings for Students.*

BOARD OF LONGITUDE.
As scientific adviser of Government, 11,117–11,133.
Remarks on the History and Position of the, by Sir G. B. Airy, App. VIII., Vol. II., pp. *31, 32.*

BOARD OF STUDIES. See *Oxford University.*

BOARD OF TRADE.
Connection of, with science, 3112, 12,620–12,703, 12,709.
Connection of, with Kew, 3112; with Standards' Department, 11,655–11,754; with Meteorological Office, 13,861–13,874, 13,904, 13,978, 14,067–14,072; with Meteorological Committee, 14,213–14,220, 14,254, 14,262.
Communication from the, respecting the Scottish Meteorological Society, App. XIII., Vol. II., p. *67.*

BOARD OF TRADE EXAMINATION. See *Examinations.*

BOARD OF VISITORS.
Desirable for Kew Gardens, 6692–6694, 6711–6713.
For new natural history museum at South Kensington, 6774.
Trustees of British Museum might be modified into a, 7225, 7226, 7454, 7483–7498, 9088–9097.
Royal Observatory board as a model for, 7485, 7486, 7489, 10,349, 12,253.
Honorary board for national collections, 9090–9097.
Desirable for every State scientific institution, 12,138–12,184, 12,188.

BOARDS OF APPOINTMENT. See *Election of Professors.*

BODLEIAN LIBRARY (OXFORD).
Scientific value of, 3284, 3288, 3302, 3589.

BOMBAY.
Meteorological establishment at, 11,478.

BONN.
Laboratories at, 47, 7185, 10,836–10,842.
Science instruction at, 7185, 7384–7391, 10,836–10,842.

BONNEY, REV. T. G., B.D.
Evidence of, 5309–5461. Analysis of Evidence, Vol. II. App. page *127.*

BOROUGH ROAD TRAINING COLLEGE.
Science and Art Department classes in, 8171–8188.

BOSTON (U.S.).
Technological school at, 1519.

BOTANICAL COLLECTIONS.
At the British Museum and at Kew, Paper on the, handed in by Mr. Carruthers, App. XV., Vol. I., pp. *44–47.*
At Kew and at the British Museum; communication Mr. Carruthers, App. I., Vol. III., pp. *1, 2.*

BOTANIC GARDENS.
At Paris, 7757.
At Dublin, 9063, 9064.
At Edinburgh, 9055.
At Glasgow, 9902, 9903.
At Kew (see *Kew*).
At Oxford, 13,754–13,810.

BOTANY.
Amount paid by State for, 115.
For elementary schools, 355, 2897, 4616.
Promotion of, by Smithsonian Institution, 1421.
Children should be trained in, 2897, 3719, 4897, 4933–4936, 8303, 8319.
At Oxford University, 3172, 3202, 3411, 3561, 3781, 3817, 4108, 4111, 4129–4143, 13,761–13,780, 13,811.
Not adapted for a school of examination, 4119–4121.
At Cambridge University, 4265, 4267, 4453, 4707, 5081, 5108, 5157, 5193, 5310, 5314, 5596, 5657.
As an educational study, 4267.
Under Science and Art Department, 4880–4886, 4896–4919, 4944.
Incompetency of teachers of, 4888–4893.
Botanical lectureships in medical schools, 4895.
Summer and winter classes for, 4921–4932, 5909–5911.
Cramming for, 4937–4939.
Microscope of great advantage in teaching, 4940, 4941.
As a subject for schools, 5226.
In Indian Civil Service examinations, 5237, 7873–7877.
Practical observation essential in teaching, 5921.
Estimate for demonstrator of, 6000.
At British Museum, 6593, 6613, 6641, 6493, 6578, 11,537, 12,186.

BOTANY—*cont.*
At Kew Gardens, 6671–6679, 7203–7211, 11,537, 11,574–11,577, 12,186–12,194.
Typical herbarium for populous districts, 6679.
In relation to palæontology, 6814–6823.
Two national establishments for, desirable, 7203–7211.
At Edinburgh University, 9264, 9312, 9379.
At Glasgow University, 9792–9794, 9901.
In German universities, 10,097.
Evil of competing State institutions for, 11,537, 11,538.
Survey expeditions might aid, 11,540.
At Queen's College, Galway, 13,156.
At Queen's College, Cork, 13,201.
Oxford Botanic Garden, 13,754–13,810.

BOURNE, A., ESQ., B.A.
Evidence of, 8160–8206. Analysis of Evidence, Vol. I. App. page *120.*

BRACKENBURY, MISS.
Contribution by, to Manchester School of Medicine, 7377.

BRADFORD.
Institution like Owens College wanted in, 1775.
Science school established by artizans at, 1958.
Philosophical Society and Science and Art Department in, 6267–6297, 6301–6306.

BRADLEY, PROFESSOR.
Rejections of Science and Art Department candidates by, 2199–2203, 2264.

BREWER, DR.
His "Knowledge of Common Things," 8334, 8335, 8337.

BREWERS.
Royal School of Mines' students studying for, 377, 5834.

BRISTOL.
Not a great centre as regards mining, 2618.
Local cultivation of science in, 6428.
Proposal to form a high science school in, 6428–6431*a*.
Museum in, 3103.

BRISTOL TRADE AND MINING SCHOOL.
Its formation, teaching, &c., 2301–2307, 2364, 2498–2618, 5945–5951, 6329–6414, 6476.

BRITISH AND FOREIGN SCHOOL SOCIETY.
Scientific instruction under, 8160–8204.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Grants by, for sun and rainfall observations, &c., 3109–3118, 10,318, 13,940–13,947, 14,059.
Might aid a council of scientific advice, 3126.
On science teaching at Rugby, 3697.
Address to, recommending museum curators to give lectures, 6597.
Might advise Government as to grants for research, 9558, 11,239.
Letter to, on State laboratories, 10,362.
As adviser of Government, 11,309.
Funds of, should be increased by Government, 11,773, 11,774.
Memorial of the, respecting Tidal Observations, App. IX., Vol. I., p. *32.*

BRITISH MUSEUM.
Natural history collections in; their great extent; crowded space; duplicates, &c., 2967, 3103–3108, 6492, 6851, 7203–7245, 7444–7582, 7715–7771, 9075–9097, 10,128, 10,159–10,173, 10,190–10,201, 11,537–11,611, 12,104–12,137, 12,939*a*–12,940.
Institutions like, should exist in universities, 3588, 3649.
Officers of, 6488–6506, 6556–6566, 6592–6616, 6641, 6824, 7455–7459, 7499, 7503, 7512–7518, 7542–7546, 7774–7778.
Foundation of, 6490.
Trustees of, 6491–6586, 6771, 7219–7226, 7454–7498, 7525, 9063–9105, 9995, 13,542–13,607.
Appointments in, 6491, 6562–6566, 7455–7459, 7499, 7503, 7512–7518, 7525, 7542–7546, 7553–7558, 9109, 13,605.
Catalogues of, 6494–6497, 6520–6526, 10,135.
Visitors to, 6498–6503, 6533, 6547–6551, 6575–6579, 6595–6597, 9112.
Lectures in, 6503–6506, 6556–6558, 6613–6618, 6641, 7460–7462, 7771–7778, 10,115–10,127, 11,537.
Difficulties with respect to dust in, 6540–6549.
Library of, 6541, 6783, 7746–7748, 7754.
Detailed labels in, 6560.
Objects obtained in Government surveys sent to, 6569, 6570, 6574.

BRITISH MUSEUM—*cont.*
Accommodation at, 6592, 6597, 6603–6605, 6620–6640, 6830, 10,118, 10,124.
Kew Museum and British Museum as competing bodies, 6660, 6661, 6680–6688, 7220, 11,537.
Too seldom open, 6779.
Might publish descriptions of acquisitions, 6838–6842.
Advantage of, to School of Mines' students, 7447.
Government of, should have a larger scientific element, 7453, 7454, 7501, 7523–7541.
Students at, 7463–7466, 7771.
Specimen cases at, might open at back, 7467, 7468.
Evening opening of, 7469–7476, 7504–7511.
Lighting up of, 7474, 7475.
Might be made more useful to science, 7482.
Public schools' men not attracted to offices in, 7515, 7518.
Education of officers at, 7518.
As to retaining collections on present site, 7547–7570.
Presidents of scientific societies as trustees of, 7559, 7565, 7566.
Library of, compared with that of Kew, for botany, 7746–7748, 7754.
Parliamentary vote for, 9055–9072.
Superfluities of objects in, should be distributed, 9073, 9074.
Committee of scientific trustees desirable at, 9100–9105.
Might be better administered, 9106–9112.
Desirability of having policemen at, 9109.
Survey expeditions have furnished little to, 10,144–10,147.
If removed, might have a biological laboratory, 10,945.
Should be more useful, 11,119, 11,264–11,271.
Chemical laboratory, microscopes, &c. at, 11,537, 11,563, 11,564.
Increased grants for, when transferred to South Kensington, 11,569.
Want of connexion between Parliament and, 11,878, 11,879.
New natural history museum, when removed, should be under a director, 12,186.
Unnecessary duplication of functions at, 12,987, 13,005–13,025.
Is supported in the general interest of science, 13,508.
Council of science not necessary for management of, 13,535–13,537.
Botanical Collections at the, and at Kew; Paper on the, by Mr. Carruthers, App. XV., Vol. I., pp. *44–47.*
Botanical Collections at the, and at Kew; communication from Mr. Carruthers, App. I., Vol. III., pp. *1, 2.*
Mineralogical Collection at the; Paper by Professor Maskelyne as to the removal of the, to South Kensington, App. XIV., Vol. I., pp. *43, 44.*

BRODIE, SIR BENJAMIN.
Evidence of, 3574–3690. Analysis of Evidence, Vol. II. App. page *90.*
On chemical teaching at Oxford, 3174.

BROUGH, LIONEL, ESQ.
Evidence of, 2494–2651. Analysis of Evidence, Vol. I. App. page *101.*

BROWN, A. CRUM, ESQ.
Evidence of, 9341–9396. Analysis of Evidence, Vol. II. App. page *166.*

BROWN INSTITUTION.
For study of diseases of animals, 10,948–10,950, 12,323.

BROWN, MR. ROBERT (The late).
His collection in the British Museum, 7729–7732, 7737.

BRUSSELS.
System for ocean observations proposed at, 14,400.

BUCHAN, A., ESQ., F.R.S.E.
Evidence of, 12,357–12,414; 14,302–14,380. Analyses of Evidence, Vol. II. App. page *204*, and Vol. III. App. page *11.*

BUCKLAND, DR.
His work at Oxford, &c., 2880, 2886, 2912, 3178, 4113.

BUILDING GRANTS.
For science purposes, 7–11, 125, 192, 233, 240.

BURDETT-COUTTS, BARONESS.
Prizes given by, 2943, 8295, 8334.

BURLINGTON HOUSE.
Scientific societies at, 10,443–10,476, 11,119, 12,598–12,600.

BURNLEY.
Instruction in teaching of science at, 5905.

BURSARIES.
At Edinburgh University, 9269.
At Glasgow University, 9566, 9567, 9905.
At St. Andrew's University, 9689–9693.
To encourage school teachers to study science, 9821.
At Anderson's University, 9987, 10,033–10,038.
At Glasgow, &c., for poor students, 12,461.

C.

CAIUS COLLEGE (CAMBRIDGE).
Promotion of science, &c. at, 4371, 5271, 5798.

CALCUTTA.
Meteorological office at, 11,478.

CALICO PRINTING AND DYEING.
Science applied to, 818–827.

CAMBRIDGE NATURAL HISTORY CLUBS.
Ray Club and Field Naturalists' Club, 5201–5204.

CAMBRIDGE OBSERVATORY.
Professor, apparatus, &c. at, 4228, 4305, 4361.

CAMBRIDGE UNIVERSITY.
Geology at, 687, 713.
Professors at, 687, 713, 3885, 4103, 4231–4249, 4291–4307, 4327–4372, 4457–4459, 4539–4802, 4950–4980, 5003, 5042–5174, 5193, 5260–5268, 5325–5406, 5466–5471, 5492–5513, 5551–5586, 5606–5665, 10,501.
College endowments for science at, 3608.
Board of studies at, 3835.
Mineralogy at, 4103, 4113.
Honours' course at, 4231–4254.
Scientific instruction at, 4232–4354, 4539–4653, 4689–4818, 4949–4984, 5098, 5107–5178.
Students at, 4231–4509, 4535–4689, 4747–4806, 4848–4852, 4959, 4984–5023, 5035–5038, 5081, 5089, 5099, 5117–5180, 5311–5458, 5494–5509, 5569–5582.
Fellowships and scholarships at, 4255–4345, 4370–4516, 4535–4641, 4756–4789, 4809, 4963–4988, 5012–5028, 5047, 5064–5067, 5109–5277, 5286, 5293–5296, 5311–5458, 5478–5536, 5559, 5568, 5594–5648.
Degrees at, 4258–4281, 4367–4445, 4566–4685, 4747–4774, 5065, 5193–5227, 5304–5306, 5429, 5565–5590.
Lectures at, 4306, 4437, 4539–4698, 5193–5266, 5310–5442, 5551, 5567, 5588.
Mathematics at, 4321–4502, 5048–5077.
Science not properly recognised at, 4323, 4324.
Professorships at, 4323–4332, 4354, 5648.
Colleges at, 4323–4485, 4535–4645, 4719–4817, 4946–5011, 5048–5081, 5109–5200, 5260–5308, 5336–5456, 5474–5665, 7897.
Funds at, 4349–4355, 4554–4650, 4708–4791, 4949–4976, 4999–5019, 5047–5071, 5108–5188, 5193, 5271, 5282, 5308, 5348–5665.
Apparatus for science teaching at, 4360, 4554–4698, 5003.
Accommodation for science purposes at, 4361–4482, 5041–5089.
Education at, too isolated, 4362, 4372, 4474, 4689.
Assistant professors and teachers at, 4365, 4465, 4708–4814, 5048–5077, 5108–5277, 5551–5588.
Examinations at, 4365–4485, 4539–4650, 4661–4665, 4959–4983, 5033–5182, 5265, 5278, 5312–5457, 5497–5509, 5569–5578, 10,742–10,770.
Vacations at, 4380, 4545–4547.
Athletics at, 4382.
Natural science tripos at, 4388–4393.
Greek at, 4635–4641, 5014.
Fees at, 4660.
Buildings for science teaching at, 4659, 4812.
Scientific education at, is theoretical, 4689.
Museums, laboratories, &c. at, 4955, 4972–4975, 5003, 5041–5089, 5108, 5167, 5354, 5363, 5471, 5551, 5584.
Exertions of, to promote science, 4999.
Literature insufficiently represented at, 5003.
Growing demand for science teaching in, 5033.
Physics at, 5068–5097.
Mechanical engineering, mining, or shipbuilding could not be studied practically at, 5109, 5190.
Laboratories at, 5193, 5268.
Boards of studies at, 5263, 5265.
Want of elasticity in system at, 5318.
Governing body at, 5318–5461, 5527–5537, 5576–5583.
Professorships at, 5354, 5433, 5492–5513.
Religion at, 5636–5652.
Objection to changing collegiate system at, 5653–5665.
Marking attendance at chapel in, 7088.
Introduction of science into, 7255.

Cambridge University—*cont.*
  Good effect of rewards for science at, 7899–7902.
  Best source for scientific education, 10,496–10,539.
  Professorial and tutorial teaching at, 10,501.
  More should be done for science by, 10,929, 10,954.
  Correspondence between Her Majesty's Commissioners and the Heads of Colleges and Halls in the, App. VI., Vol. I., pp. *9–31*.
  Endowments and Parliamentary Grants, App. VI., Vol. I., pp. *14–19*.
  Information respecting Fellowships at the several Colleges, App. VI., Vol. I., pp. *28–31*.

Cambridge University Commission.
  Proposals of, 5109, 5552.

Cambridge (U.S.).
  Museum at, 1531–1534.

Canada.
  School of Mines students from, 656, 757.
  Mining school in, 2471.
  Meteorological instruction in schools in, 12,514.

Candidates (Science and Art Department). See *Science and Art Department.*

Canterbury, Archbishop of.
  Appointing trustee of British Museum, 6491, 6562–6566, 7456, 7525–7663.

Cape of Good Hope.
  Observatory wanted at, &c., 757, 13,071.

Cardiff.
  Mining school desirable at, 2510.

Carlsruhe.
  Science instruction in, 7389, 10,385.

Carpenters and Joiners.
  Technical education of, 1957, 6085.

Carpenter, W. B., Esq., M.D.
  Evidence of, 7864–7902; 10,920–10,962. Analyses of Evidence, Vol. II. App. page *145*, and page *194*.

Carruthers, W., Esq., F.R.S.
  Evidence of, 7714–7760. Analysis of Evidence, Vol. II. App. page *139*.
  On South Kensington plans for British Museum, 6604.
  Paper handed in by, on the Botanical Collections at the British Museum and at Kew, App. XV., Vol. I., pp. *44–47*.
  Communication from, on the Botanical Collections at Kew, and at the British Museum, App., I., Vol. III. pp. *1*, *2*.

Cartmell, Rev. J., D.D.
  Evidence of, 5462–5545. Analysis of Evidence, Vol. II. App. page *129*.

Catalogues.
  British Museum, 6494–6526, 6840, 10,132–10,135.
  Hunterian Museum, 6587–6591.
  Royal Society's, 10,603–10,606.
  See *Scientific Publications.*

Catechetical Instruction.
  Application of, 1148.

Catholic University of Ireland.
  Promotion of science at, 13,361–13,506.
  Statement respecting the, App. VI., Vol. II., pages *20–25*.
  See *the Evidence of Dr. Lyons, Professor Sullivan, and Professor Hennessy in Vol. II., pp.* 325–338.

Catholics. See *Religion.*

Cayley, Professor.
  Communication from, respecting the proposed establishment of a Physical Observatory, App. VII., Vol. II., p. *31*.

Central Science School. See *Metropolitan College of Science (proposed).*

Certificated Masters.
  As teachers of evening science classes, 183.

Certificates.
  For teachers, &c., 8908–8910, 9506–9508, 9527–9529, 2153, 2218–2222.

Chadwick, Edwin, Esq., C.B.
  On national museums, Vol. II. page 368.

Chairs. See *Professorships.*

Challis, Professor.
  Evidence of, 4227–4303. Analysis of Evidence, Vol. II. App. page *107*.
  Teaching of, at Cambridge, 4324, 4333.

Chancellor, Lord.
  Appointing trustee of British Museum, 6491, 6562–6566, 7456, 7525, 7556, 7663.

Chancellor of Cambridge University.
  Laboratory, &c. instituted by, at Cambridge University, 4401, 5070, 5071, 5108.

Charles Science School, Plymouth.
  Establishment of, 2064–2088.

Cheltenham College.
  Science at, 4531, 4606, 4629–4633.

Chemical Analyses.
  Ignorance of Science and Art Department candidates respecting, 766.
  For public offices, &c., 5768–5774.

Chemical Laboratories.
  Should be founded in every chief town, 2716.
  See *Laboratories.*

Chemistry.
  Instruction in, 115–469, 734–831, &c.
  Should be taught in elementary schools, 355, 3719.
  At School of Mines, 365, 377, 464–469, 734–753, 2446–2482, 5690–5834, 13,055, 13,074–13,093.
  Under Science and Art Department, 762, 800, 6105–6107, 2154, 2260, 8513.
  Should be taught throughout the country, 793.
  Advantage of, in dyeing, 818–827.
  Superior knowledge of, in Germany and Switzerland, 832–835.
  At School of Naval Architecture, 943, 980–982, 1007, 1151.
  Class at Oldham, 1802, 1910.
  In East Lancashire, 2154.
  Objection to teaching technical, 2793, 2844–2849.
  At Oxford University, 2895–2898, 2979–4214, 4820, 4836.
  As an application of the higher physics, 4267–4270.
  At Cambridge University, 4394–5609.
  Marks for, in Indian Civil Service examinations, 5237.
  In Prussian universities, 5792, 5868, 5869.
  Fellowships for original research in, 5880.
  At Owens College, 5882, 7253, 7364–7422.
  At University and King's Colleges, 5814, 7132–7201.
  Might be taught to boys under 13, 5856–5859.
  In Liverpool, Bradford, and Huddersfield, 5941.
  In Bristol Trade School, 5945, 6330.
  Accommodation for, in new buildings at Kensington, 5986–6044.
  At King's College, 6883–7023, 7092.
  At Abbott's Ann School, 8311.
  In the Pottery districts, 8469, 8489, 8509–8513.
  In Birkbeck schools, 8739–8741.
  In Yorkshire, 8891.
  Knowledge of, essential to geology, 7625–7628.
  Advantage of training in, 7878, 7897.
  At Newcastle College of Science, 8766–9194.
  Want of knowledge of, among chemical manufacturers, 9204–9206.
  At Edinburgh University, 9264–9501.
  At Glasgow University, 9506, 9802–9932.
  At St. Andrew's University, 9625–9764.
  Demand for teaching of, in Dundee, Cupar, &c., 9770.
  At Anderson's University, 9950–10,044.
  Applications of, to manufactures, &c., 10,059–10,441.
  Government should aid, 10,519, 10,683, 10,689, 10,696–10,714, 10,736, 10,782–10,812.
  Chemical laboratories in Germany, 10,822–10,845.
  Chemical science is in a better position than biological, 10,921.
  Research in, in France and Germany, 11,053–11,061.
  National laboratory for, desirable, 11,064–11,073, 11,354, 13,054–13,118.
  Laboratory for, in connexion with British Museum, 11,357, 11,563, 11,564.
  Laboratory for, would be serviceable to Standards' Department, 11,749–11,751.
  Teaching of agricultural chemistry in Scottish schools, 12,460.
  At Dublin University, 12,763–12,958.
  Laboratories for, in observatories for astronomical physics, 13,066–13,073, 13,121–13,124.
  At Queen's College, Galway, 13,153.

Chemistry—*cont.*
At Queen's College, Cork, 13,217–13,220.
At Queen's College, Belfast, 13,270–13,307.
At Catholic University of Ireland, 13,428–13,432.

Chemists.
Employment for, 1559, 6136, 6137.

Chief Constructor of the Navy.
Application of theoretical knowledge to naval architecture by, 926.

Children.
Scientific teaching for, 315–349, 569, 576, 605, 631, 862, 1013–1016, 1664, 1729, 1736, 1809–1889, 1941–1991, 2210, 2276, 2415–2418, 2781, 2897, 3056–3096, 3577–3722, 3971, 4303–4339, 4603–4631, 4896–4936, 5225–5256, 5922–5952, 6123–6198, 6445, 6476, 6920, 7033–7073, 7143–7150, 7816–7820, 7926–8087, 8144–8155, 8297–8973, 9880.
At Hull school, 862.
Greek for, 3720–3722, 3971.
At Harrow, Rugby, &c., 4631.
In Bristol Trade School, 5945.
At King's College, 6920, 7033–7036.
At University College School, 7143–7820.

Chisholm, H. W., Esq.
Evidence of, 11,655–11,754. Analysis of Evidence, Vol. II. App. page *211*.

Christ Church College (Oxford).
Scientific instruction, &c., at, 2880–4214.

Christ's College (Cambridge).
Taxation for University purposes at, 5109.

Cirencester College. See *Agricultural Colleges.*

Civil Engineering. See *Engineering.*

Civil Engineers' College at Putney.
Objection of civil engineers to, 2424.
See *Indian Civil Engineering College, Cooper's Hill.*

Civil Service Commission.
Geological Survey appointments under, 523–528.
British Museum appointments under, 7516.
Objection to competitive examinations of, 6773, 11,760–11,768, 13,492.

Clare College (Cambridge).
Science teaching at, 5295–5303.

Clarendon, Lord.
Hyde Institute and "History" of, 4158.

Clarendon Press (Oxford).
Income from, disbursed for University purposes, 3291–3295.

Clark, Rev. W. G., M.A.
Evidence of, 5546–5591. Analysis of Evidence, Vol. II App. page *130*.

Class Distinctions and Restrictions.
As affecting scientific instruction, 6445–6456.

Classes, Evening. See *Evening Classes.*

Classification of Trades.
Advantage of, 1852.

Classics. See *Literature.*

Clausthal.
Mining school at, 2325.

Clergymen.
At Cambridge, do not read much science, 4477, 4478.
Science important to, 4513–4516, 4520–4526.
Education questions at Cambridge are too much decided by, 5318, 5321.
Cambridge fellowships held by, 5566.

Clifton College.
Science teaching at, 4629.

Clifton, R. B., Esq., M.A.
Evidence of, 2978–3099. Analysis of Evidence, Vol. II. App. page 77.

Coal.
Waste of, for want of scientific knowledge, 482, 2391, 2452.
Coal-mining industry aided by Geological Survey, 703–708, 754.

Coast Surveys.
In America, 1442, 1461–1465.

Coinage.
Standard trial plates at the Mint, 11,656, 11,751, 11,753.

Cole, Henry, Esq., C.B.
Evidence of, 1–250; 5953–6112; 9055–9148. Analyses of Evidence, Vol. I. App. page *61*, and Vol. II. page *140*.
On ascertaining qualifications of teachers, 273.
On removal of School of Mines, 2469–2476, 2483, 2485.
Consulted as to Government appointments, 1209, 1210.

College of Science. See *Metropolitan College of Science (proposed).*

College of Surgeons. See *Hunterian Museum.*

Colleges.
Objection to Government colleges, 1580, 1584, 1594, 1601, 1604, 1756–1768, 7104.
Might supply scientific staff of India, 7105–7108.
Normal training colleges should be under one department, 9589–9591.
At St. Andrew's University, 9626, 9631, 9656–9682, 9716–9719.
Government aid to, 11,354, 13,524.
See *Cambridge University; Oxford University; Training Colleges.*

College Tests.
Better than examination tests alone, 1186–1189.

Collieries.
Training of managers of, 2335.

Colliery Viewers.
Objection of, to School of Mines' courses being substituted for apprenticeship, 2335, 2424–2427.
Mining inspectors are chosen from, 2459.

Collusion.
Between students and teachers, 35–37, 6433, 6436, 6444.

Colonies.
Appointments to, of School of Mines' students, 437, 741.
Scientific administration in, 11,890.
Meteorological organizations in India, New Zealand, &c., 13,952–13,955.
Photographic meteorological observations at Toronto, 14,161.

Colour Shops.
More scientific methods desirable for, 814–827.
Instruction wanted between, and Owens College chemistry classes, 7393–7401.

Columbia College (New York).
Apparatus, education, &c. in, 1519, 1558–1561.
School of Mines at, 2471.

Commerce.
Proposal to include, in a high science school at Bristol, 6428–6431.

Committee of Council on Education. See *Education Department.*

Committee of the Privy Council on Education.
Minute of the Lords of the, on the instruction given in the Schools of Science under the Science and Art Department, App. XIX., Vol. I., page *57*.

Committees.
Great amount of voluntary work done by, 13,532.
Objection to unpaid committees, 14,061.

Committees, Local. See *Local Boards.*

Communication.
From John Anderson, Esq., C.E., Superintendent of Machinery to the War Department, App. XII., Vol. II., pages *62–64*.
From the Board of Trade respecting the Scottish Meteorological Society, App. XIII., Vol. II., page *67*.
From the Scottish Meteorological Society, App. XIII., Vol. II., pages *64–67*.
From George Gore on the Advancement of Science, App. X., Vol. II., pages *33–41*.

Competition.
Of State and private institutions, 116–129, 249, 1069–1071, 1175–1177, 1196, 1214, 1253–1259, 1306–1313, 5790, 5814, 6033.
Of foreign artizans with English, 1970, 1973, 2000–2004.

Competitive Examinations.
Objections to, 1585, 1659, 1662, 1747, 1750, 5896.
See *Examinations.*

COMPULSORY EDUCATION.
  None in American schools, 8298.
  Desirable, but the way not clear, 8302, 8701.
  A system of, should be inaugurated, 1946–1948, 1994.
  Essential for science teaching, 1994–1996.
  No feeling against, in Switzerland, 2014–2018.

CONCHOLOGY.
  Lectures on, might be given at British Museum, 6593, 6613, 6641.

CONGRESS. See *America.*

CONSERVATOIRE DES ARTS ET MÉTIERS, PARIS.
  A model for our Patent Museum, 9099, 9132–9142, 10,434–10,442, 13,846–13,851.
    And see *Appendix III. to Report on Museums (4th Report).*

CONSTRUCTION, MACHINERY, AND BUILDING.
  Taught in Bristol Trade School, 5945.

CONTINENT.
  Scientific education on the, 1584, 1615, 1673–1677, 1693–1695, 1755, 8110, 8140–8143, 9157, 9236, 10,339, 10,560–10,565, 11,037.
  Continental polytechnic schools, 1584, 1673–1677, 1755.
  Drawing by continental workmen, 1704–1706.
  Competition of continental with English engineers, 1693–1695.
  Competition of foreign artizans with English, 1970, 1973, 2000–2004.

CONTINENTAL SCIENCE SCHOOLS. See *Science Schools.*

CONTRIBUTIONS FOR SCIENCE PURPOSES.
  In Plymouth, 2101.
  In East Lancashire, 2163–2167.
  Of artizans, to educational institutions, 2239.
  Expected from persons connected with mining, 2447.
  Assessment in lieu of, 2449–2455.
  Offers of, from Cornwall and Newcastle, 2465.
  Withdrawn from Bristol and Glasgow mining schools, 2502, 2507–2510, 2626.
  Difficulty of supporting science schools by, 2617.
  By Dr. Neil Arnott, &c., 2661.
  Supplementing, by Government grant, 2688–2692, 2783.
  By provincial institutions, 3163.
  At Oxford, 3280–3289, 3301–3303, 3314.
  In Yorkshire, 6145–6147.
  In Bradford, 6295–6297.
  In Bristol, 6356, 6392, 6431*a*.
  For University College, 7132–7142.
  For Owens College, 7258, 7266, 7298, 7377.
  Manufacturers might aid technical classes by, 8898.
  To Anderson's University, 9985–9987.
  Would result, if Government took initiative, 12,230, 12,267, 13,508–13,513.
  Of Catholics to Catholic University of Ireland, 13,369–13,372.
    See *Grants in aid of Science. Income and Expenditure.*

COOKING.
  Taught in Stockwell Female Training College, 8169.

COOKSON, REV. H. W., D.D.
  Evidence of, 5102–5191. Analysis of Evidence, Vol. II. App. page *121.*

COOMBER, THOMAS, ESQ.
  Evidence of, 6324–6431. Analysis of Evidence, Vol. I. App. page *111.*

COOPER'S HILL COLLEGE. See *Indian Civil Engineering College.*

COPPER AND ZINC MINES.
  Scientific knowledge applied to, 2345–2351.
  Foreigners as managers, &c. in, 2367–2369.
  Scientific processes in, 2392–2394.

CORK. See *Queen's College, Cork.*

CORNWALL.
  Memorial from, to establish a mining institution, 702.
  Scientific knowledge in, 2301–2465.

CORPUS CHRISTI COLLEGE (OXFORD).
  Professorship in law at, 4189.

CORRESPONDENCE.
  Between Her Majesty's Commissioners and the Heads of the Scottish and Irish Universities, App. V., Vol. II., pages *5–19.*
  Between Her Majesty's Commissioners and the Warden of the University of Durham, App. IV. Vol., IV., page *5.*
  Between the Treasury and the Registrar-General, relative to certain Meteorological returns furnished to him by Mr. Glaisher, App. II., Vol. III., pages *2–5.*
  Of Her Majesty's Commissioners with General Sir Edward Sabine, as President of the Royal Society, respecting the Government grant to the Society in aid of Scientific Research, App. XI., Vol. II., pages *41–62.*
  Relating to the First Report of the Royal Commission on Scientific Instruction and the Advancement of Science, and a Memorial to the Department of Science and Art by the Director of the Royal School of Mines, App. III., Vol. II., pages *2–4.*
  With Her Majesty's Commissioners and the Heads of Colleges and Halls in the Universities of Oxford and Cambridge, App. VI., Vol. I., pages *9–31.*

COSSHAM, MR.
  Support given by, to Bristol Trade School, 6400.

COST.
  Of School of Mines' students, 443–563.
  Of College of Chemistry, 499, 504, 512.
  Of instruction in School of Naval Architecture, 1041, 1123–1125.
  Of laboratory at Glasgow University, 2768.
  Of Oxford Museum, 2903–2907, 3449, 3787–3869.
  Of new building, &c. for physics, at Oxford, 2984–2986.
  Of instruction at Bristol Trade School, 6355–6357 6402.
  Increase of science teaching involves increase of, 6445–6486.
  Of laboratories, &c. at Owens College, 7369, 7377.
  Of laboratories, &c. in Germany, 7384–7406.
  Of science colleges would be repaid in training of teachers, 7435.
  Of training colleges, 8230.
  Of instruction of children by Education Department, 8415–8418, 8436–8445, 8459–8463.
  Of successful schools greater than of unsuccessful, 8443–8445.
  Of masters, &c. in elementary schools, 8672–8675.
  Of visitors at Crystal Palace, 9067.
    See *Income and Expenditure.*

COUNCIL OF EDUCATION.
  Suggestion respecting, 1232–1273.
    See *Council of Scientific Advice.*

COUNCIL OF INDIA. See *India Office.*

COUNCIL OF PROFESSORS OF ROYAL SCHOOL OF MINES.
  Opinion of, not taken on proposed removal of School, 2480.

COUNCIL OF SCIENTIFIC ADVICE.
  Objection to, 10,492–10,522, 11,357, 11,545–11,562, 12,138–12,184, 13,514–13,638.
  Desirability of instituting, 1271, 1388–1390, 1658–1661, 1761–1764, 2693–2697, 2723–2725, 2867, 3113–3150, 3205–3209, 6775–6778, 7436–7439, 7704–7710, 10,222, 10,661–10,777, 10,813–10,818, 10,895–10,897, 10,984–11,522, 11,580–12,096, 12,245–13,136.

COURTS OF JUSTICE.
  Objection to system of scientific evidence in, 11,074–11,081.

CRAMMING FOR EXAMINATIONS.
  Detection of, &c., 156–164, 256–273, 569, 632, 776, 1903, 4888–4939, 5952, 6099–6103, 1187*a*, 1963, 2085–2254, 3065, 4321, 4610, 4888–4939, 5236, 5952, 6099–6103, 6129, 6190–6196, 6251, 9886, 13,500.
    Observations on, by Prof. Hennessy, App. VI., Vol. II., pages *25–27.*

CREUZOT.
  Messrs. Schneider's schools at, 1969.

CROMWELL, REV. J. G., M.A.
  Evidence of, 7903–8031. Analysis of Evidence, Vol. I. App. page *116.*

CROWN, THE.
  Edinburgh University natural history specimens handed over to, 9471–9482.

CRYSTALLOGRAPHY.
  At Oxford University, 4091–4099, 4108.
  Essential for physicists, chemists, and geologists, 4100, 4132.
  Amount of mathematics essential for, 4101.
  In England, at the lowest ebb, 4103–4105.
  At Universities, 4106, 4113.

CRYSTAL PALACE.
  Cost of visitors at, 9067.

CUNNINGHAM, J. W., ESQ.
  Evidence of, 7003–7078. Analysis of Evidence, Vol. II. App. page *155.*

Cunningham, R. O., Esq., M.D.
  Evidence of, 13,316–13,360. Analysis of Evidence, Vol. II. App. page *185*.

Cupar.
  Chemical instruction in, 9771.

Curators. See *Directors, Curators, &c.*

Curtis, A. H., Esq., LL.D.
  Evidence of, 13,170–13,199. Analysis of Evidence, Vol. II. App. page *183*.

D.

Daglish, Mr.
  On contributions of employers to science schools, 2304.

Daily Lesson Books.
  Of British and Foreign School Society, 8161–8168, 8194–8196.

Dalton Scholarships.
  In Owens College, 5882, 7412–7420.

Darwin, Mr.
  On a national botanical collection in London, 7739–7740.

Dawes, Dean.
  Efficiency of King's Somborne School and Hereford Bluecoat School owing to, 8303–8312.

Dean.
  For proposed new training college, 5850–5853, 5953.

Deep-Sea Dredging. See *Survey Expeditions.*

Degrees.
  At Glasgow University, 2682, 2837–2841, 9506, 9578, 9597, 9840–9928.
  Performing a piece of work for, 2833–2836.
  Less classics, and more science, desirable for M.A. degree, 2840.
  At Oxford University, 2895–3704, 3754–4086, 4204, 4852, 13,761–13,780.
  Degree of Master or Bachelor of Science desirable, 3359.
  In arts, might be almost confined to non-professional men, 3361.
  Greek for, 3578, 3897, 3917, 4875.
  "Private study" candidates for London University B.A., 3850.
  Degree in one school preferable to pass through two, 4005, 4084.
  Long reading for examination after taking, beneficial, 4059–4063.
  At Cambridge University, 4235–4852, 5034–5590.
  At London University, 7132–7150, 7674–7835, 7870–7893.
  Multiplication of, in America and Germany, 7351.
  Competition between different educational institutions in giving, 7357.
  At Edinburgh University, 9291–9496.
  Honorary degrees only should be given by universities, 9458.
  To teach, not to give degrees, is the primary object of an University, 9458.
  Of Scottish Universities, accepted for Department science teachers, 9597.
  At St. Andrew's University, 9627–9631, 9711, 9763, 9787.
  Scottish arts degrees, 9858–9865.
  Science degrees should be given on an elastic system, 9868–9871.
  Anderson's University cannot grant degrees, 9991, 9993.
  Original research required for, 11,064, 11,815–11,819.
  At Dublin University, 12,735–12,958, 13,177–13,191.
  At Queen's College, Galway, 13,140, 13,147.
  At Queen's University, Ireland, 13,207, 13,220, 13,408, 13,413, 13,472–13,479.
  At Catholic University of Ireland, 13,414–13,417, 13,496–13,499.
  Objection to a body merely for giving degrees, 13,500.

De la Beche, Sir Henry.
  Connection of, with Jermyn Street Institution, &c., 464–466, 674.

De la Rue, Warren, Esq., D.C.L.
  Evidence of, 13,034–13,137. Analysis of Evidence, Vol. II. App. page *207*.

Demonstrators. See *Assistant Professors, Demonstrators, &c.*

De Morgan, Professor.
  Teaching of mathematics by, 7146.

Derby, The Right Hon. E. H. S., Earl of.
  Evidence of, 13,507–13,551. Analysis of Evidence, Vol. II. App. page *208*.

Denbighshire.
  Desire in, for geological maps, 754.

Denmark.
  Connexion of natural history collections with schools in, 10,304.
  Co-operation with, for meteorological purposes, 14,148.

Department of Practical Art.
  Change of, into Department of Science and Art, 2.

Department of Science and Art. See *Science and Art Department.*

Deputation from Society of Arts.
  On national museums, Vol. II. page 365.

Deputation from the University of Edinburgh.
  As to the proposed extension and improvement of the buildings, Vol. III. pages 60–63.

Devon.
  Memorial from, for a mining institution, 702.

Devonport.
  Science classes at, 2135.

Diagrams.
  Convenience of, for teaching, 7451.

Diaries.
  For Admiralty students, 907, 953, 990, 1051–1053.

Dick Bequest.
  Elevated standard of school teachers in Scotland through, 9700.

Directors, Curators, &c.
  Director for meteorology may become essential, 14,226, 14,291.
  Of British Museum, 6493–6642, 6824, 7243–7248, 7454–7546, 7723–7778.
  Of Kew, 6657–6758, 7243–7248.
  Of new natural history museum, 6770–6828, 6856–7210.
  Tendency of distinguished curators to neglect mechanical work, 7217.

Directory (Science and Art).
  For grants, text-books, &c., 2, 1616, 1641, 2155, 2174, 2183, 6249, 6445, 6456.

Dissections.
  Exhibition of, by Mr. Robertson, 2966.

Dissertations.
  Desirable here, as in German universities, 5876–5889.

Divinity. See *Religion.*

Dockyards.
  Students of School of Naval Architecture in, 1049–1053.

Dockyard Schools.
  For engineer students, &c., 884–1168, 2064–2079.

Domestic Economy.
  Taught at Stockwell Training College, 8169.

Donnelly, Major, J.F.D., R.E.
  Evidence of, 5953–6112, 6432–6487, 13,832–13,860. Analyses of Evidence, Vol. I. App. pages *61*, *106*, and Vol. II. App. page *144*.
  References to evidence, &c. of, 2, 218, 340, 2469, 2484, 5953, 5973, 5980.

Dowlais.
  Wages in, and mining school for, 2588–2591.

Downing College (Cambridge).
  Scientific instruction at, 4300, 4326, 4372, 4436, 4507.

Drawing.
  Importance of, &c., 621, 1615–1629, 1704–1706, 1787, 1802, 1893–1896, 1920–1923, 1957, 1969, 6329, 6335, 7985, 8469, 8483, 9507–9513.
  Ability of continental workmen in, 1615, 1704–1706, 1969.
  Can be usefully taught in elementary schools, 7985.
  Want of, in Glasgow University, 9507, 9513.

Drawing, Teachers of.
  Same teacher should not instruct in freehand and mechanical drawing, 1629.

DUBLIN.
Vote for science and art collections in, 9062, 13,859.
Cost of museums, &c. in, 13,859

DUBLIN UNIVERSITY.
Promotion of science in, 12,729–13,176, 13,419.
Statement respecting the Science School of the, App. V., Vol. II., pages *16*, *17*.

DUNCAN, P. M., ESQ., M.B.
Evidence of, 7583–7713. Analysis of Evidence, Vol. II. App. page *158*.

DUNDEE.
Scientific instruction at, 9646–9784.

DURHAM.
Promotion of science in, 2506, 2544, 2647, 6207, 8757, 8762, 8793–8804.

DURHAM UNIVERSITY.
Aid to Newcastle College of Science by, 8757–8788, 9151, 9198–9202.
Scientific instruction at, 8763, 8777–8782.
Association of colleges with, 8785–8788.
Correspondence between Her Majesty's Commissioners and the Warden of the, App. IV., Vol. II., page *5*.

DUST IN MUSEUMS.
Injury from, 6540–6546, 6549, 6721–6725.

DYEING.
Chemical knowledge in relation to, 377, 818–827, 1793, 1974, 6138, 6302.
Classes for instruction in chemistry of, 8889–8891.

E.

EARNINGS.
Of teachers of science, &c., 139–141, 5954.

EARDLEY-WILMOT, MAJOR-GENERAL F., R.A.
On national museums, Vol. II. page 365.

ÉCOLE DES ARTS ET MÉTIERS, PARIS.
Approximation to workshop at, 1759.

ÉCOLE DES MINES, PARIS.
Royal School of Mines compared with, 543–546.
Intended for mining engineers, 2378.
Receives a large sum from the State, 2463.

ÉCOLE DU GÉNIE MARITIME, PARIS.
Education in, 1063–1067.

ÉCOLES DE MAISTRANCE.
In French dockyards, 1087.

ECONOMIC SCIENCE.
At University College School, 7156–7158.

ECONOMY.
In School of Mines, effected by union with Geological Survey, 2456.
Effected by affiliation of mining school to trade school at Bristol, 6335.
Would be effected by union of science schools, 6428–6430*a*.
Want of proper definition of, 8035, 8112–8116.

EDINBURGH.
Scientific instruction in, 1615, 1618, 1630–1656.
Not room for another university in, 1667.
Vote for science and art collections in, 9062, 13,859.
Has been a great training school for professors, 9314.
Advantage of, as a locality for teaching geology, 9502.

EDINBURGH MUSEUM OF SCIENCE AND ART.
Aim of, &c., 9055–9072, 9349–9354, 9471–9487.

EDINBURGH, THE ROYAL OBSERVATORY AT.
Statement respecting the, by Professor Piazzi Smyth, App. V., Vol. II., pages *14–16*.

EDINBURGH UNIVERSITY.
Science teaching in, 1630–1721, 2726, 2871, 9262–8503, 9729–9733, 9773, 10,202–10,310, 12,304.
Lectures to ladies at, 2726.
Dissatisfaction with site and buildings of, 2871.
Detailed statement as to scientific instruction and the means available for the advancement of science in the, with suggestions for the improvement of the same, App. V., Vol. II., pages *8–14*.

EDUCATION.
Scientific education in 1853 and 1867–8, 2, 115.
State aid essential for introducing science into, 114.
Want of elementary, 569, 1806, 1809, 1887.
In America; Minister for, appointed, 1454, 1539.

EDUCATION—*cont.*
Of engineers, medical men, and telegraph officers, 1580–1756.
Of English compared with foreign miners, 2400–2402.
Of Cornish miners, 2415.
Literature with science in, 3231, 3691, 3634–3638, 3755, 3860, 7113.
At Oxford University (see *Oxford University*).
Latin and Greek for natural science students, 3274, 3917.
Endowed schools should teach science, 3418.
Higher education in universities, 3582, 3626–3629.
In German realgymnasia, 3744.
Separate literary and scientific education in Germany, 3855.
Standard of school education is improving, 4028.
At Cambridge University (see *Cambridge University*).
Of a clergyman, cannot be too liberal, 5651.
Advantage of continuing, in night classes, 6340.
At King's College (see *King's College*).
At University College (see *University College*).
At Newcastle College of Science (see *Newcastle College of Science*).
Museums as instruments of, 9118–9131.
Of persons engaged in manufactures, &c., 9204–9206.
Drawing an important element of, 9510.
At Glasgow University (see *Glasgow University*).
Lowering standard of, in Scottish training schools, 9579–9587, 9591.
Should be framed with respect to scientific training, 12,981.
Imperfect preliminary education of Irish students, 13,201.
Want of appreciation of, in Ireland, 13,440, 13,444, 13,453–13,462.
Advancement of science a pressing want of our system of, 13,559.
Government should aid scientific, along with general, 13,623–13,625.
Endowments for, should be utilized for science, 13,627.
Valuable educational library and museum in South Kensington Museum, 13,833.
See *Compulsory Education.*

EDUCATION ACT.
Good results expected from, 6225, 8348, 8574, 8599–8604.

EDUCATION DEPARTMENT.
Connexion of, with Science and Art Department, 354 1952, 2039, 2278–2284, 6461–6467, 8072–8077, 8365, 8385, 9588–9594.
Want of confidence in, 2152, 2284–2287.
One system of graduated inspection under, 5974–5976.
Payment by, of teachers of art, 6089.
Instruction in science in schools subject to action of, 6457.
No payment by, to pupils paid by South Kensington, 6458.
Might encourage science in training colleges, 8284, 8286.
School inspectors of, might supervise science classes, 8360–8364.
Science in elementary schools under, 8367–8369, 8377–8384.
Promotion of science instruction for schoolmasters by, 8398.
In connexion with evening classes, 8974–8977.
Suitable to deal with Government scientific matters, 11,875–11,878.
Council for science should be under, 11,946, 11,959–11,962.
Preferable, for science, to a special minister, 13,577.
British Museum might be connected with, 13,579–13,581.

EDUCATION (PUBLIC).
Extracts from Notes on, App. V., Vol. I., page *8*.

EGERTON, SIR P. DE M. G., BART., M.P.
Evidence of, 7519–7582. Analysis of Evidence, Vol. I. App. page *139*.

ELECTION OF PROFESSORS, &c.
Method of, 3132, 3240, 3248, 3264–3267, 3607, 3680.
At Oxford University, 3249–3549.
Radcliffe trustees' board of election, 3598.
Small board for scientific appointments, 3601–3604.
Objection to convocation appointing to scientific boards, 3602.
Special boards of appointment for each professorship, 3603–3605.
Eminent foreigners might be elected to professorships, 3606.
Oxford University Commission allowed election of professors to fellowships, 3680.
Election of heads of college at Cambridge University, 4377–4379.

ELECTRICITY.
Instruction in, at University College, 7823.
Experiments in, for Board of Trade, 12,623–12,631.
Atmospheric electricity at Greenwich, Oxford, &c., 14,021, 14,055, 14,051, 14,097.

ELECTRIC TELEGRAPHS. See *Telegraphy*.

ELEMENTARY CLASSES AND SCHOOLS.
Continuance of instruction received in, 813.
Instruction in science of teachers of, 5793–5799.
Chemical teaching in, 5856–5862.
Teachers of science in, should receive State payment, 6445.
Payments for science instruction in, 6452.
See *Elementary Schools*. *Schools*.

ELEMENTARY EDUCATION.
Scientific teaching a fundamental part of, 314.
Want of, 569, 1806, 1809, 1887.
In dockyard schools, 1018.
Approval of payment on results for, 1615.
Necessity of instruction in art of teaching, 6003.
Not contemplated in proposed training college, 6040–6042.
For adults, in Yorkshire, 6117.
See *Education*.

ELEMENTARY SCHOOLMASTERS.
Instruction of, &c., 614, 7338–7347, 8117–8129, 8302–8399, 8474–8538, 8649–8722.
Owens College a good centre for instructing, 7344, 7347.
Greater efficiency of, desirable, 8302.
Insufficient means for training, 8348.
Instruction in science for, 8398, 8474–8538, 8477, 8649–8721.
Masters trained in science would find work, 8522.
Payments to, 8672–8675.
See *Schoolmasters*. *Science Teachers*. *Teachers*.

ELEMENTARY SCHOOLS.
Teaching of science in, &c., 12, 305–356, 1199–1203, 1428–1434, 1563, 1795–1897, 1940–1994, 2015, 2149–2305, 2686, 4907–4934, 5921–5952, 6123–6182, 7926, 7982–8030, 8144–8756, 8922–8970.
Necessity for practical instruction in, 321.
Should be supplemented by secondary schools, 324.
In America, 1428–1434, 1563.
In Oldham, 1795, 1799, 1800, 1807.
Mining and mineralogy as subjects for, 2295–2297, 8647, 8651, 8697.
Applied subjects should not be taught in, 2305.
Science teaching in, urged by Glasgow University, 2686.
Botany might be taught in, 4933.
Subjects most fiting to be taught in, 5922.
Necessity of a separate grade of, 5955.
One system of graduated inspection for, 5974–5976.
Scientific instruction of children in (see *Children*).
Lower standard of examination in science desirable for, 6150–6153.
Physical geography as a subject for, 7926, 7982–7984.
St. Mark's College trains for teachers in, 7949.
Drawing and mensuration in, 7985.
Modification of infant and juvenile schools desirable, 8144–8148.
Approval of, in Switzerland, 8149–8157.
Of British and Foreign School Society, 8189.
Endowments in, 8219.
Wesleyan Training College, Westminster, 8033, 8070.
Rural schools, 7931–7933, 8293–8295.
Compulsory attendance in, 8302.
King's Somborne, Abbott's Ann, and Bluecoat School, in Hereford, 8303–8312.
Science in, under Education Department, 8367–8369, 8377–8384.
Allowances for children in, under New Code, 8415–8463.
Compulsory teaching of music in, under New Code, 8451–8458.
Subjects taught in, under Mr. Corry's minute, 8464.
Science teaching in, before Revised Code, 8465–8498.
Grants for "specific subjects" in, 8468 (*note*).
Objection to much science being taught in, 8472–8598, 8616–8620.
In Black Country, 8501.
As affected by Education Act, 8574–8604.
Little science in, under Education Department, 8608–8615, 8621.
Higher teaching in, under New Code, 8623–8633, 8668–8671, 8676–8686, 8719.
Teaching social science in, 8751–8756.
Best boys in science in, are best in other subjects, 8929.
See *Schools*.

ELEMENTARY SCIENCE.
Teaching of, 804–813, 1806–2041.
In Oldham, 1806–1819.
Advantage of, to workmen, 1919.
For children and artizans, 1943–1953, 2041.
In Germany and Switzerland, 5863–5865.
See *Science*.

ELEMENTARY SCIENTIFIC INSTRUCTION.
Aid given to, under the Science and Art Department, App. I., Vol. I., page *1*.

ELEMENTARY TEACHERS.
Might teach science in the evening, 5966.
Science teachers need not be elementary teachers, 6025.
See *Schoolmasters*. *Teachers*.

ELLIS, W., ESQ.
Evidence of, 8725–8756. Analysis of Evidence, Vol. I, App. page *125*.

ELSWICK.
Evening science classes at, 9229–9235.

EMPLOYERS.
Should establish trade schools, &c., 1946–1948, 2032, 2042–2045.
Not unwilling to assist science classes, 2303.

ENDOWED SCHOOLS. See *Schools*.

ENDOWED SCHOOLS' COMMISSION.
Science teaching in schools under, 1734, 2928, 3058–3061, 3090, 3195–3199, 3578, 3634–3636, 3694, 4635–4641, 6149, 8219–8262, 8387, 12,203.
Proposal respecting Greek by, 3578, 3754.
And Yorkshire College of Science, 6149.
Science compulsory in schools under, 8219–8261.
Laboratories and exhibitions permitted by, 8254, 8262.
Extended instruction expected to result from, 8387.

ENDOWED SCHOOLS' COMMISSION.
Letters from the Chairman of the, to the Vice-Chancellors of the Universities of Oxford and Cambridge, App. VIII., Vol. I., pp. *32*, *33*.

ENDOWMENTS.
Wanted, at universities, for science, 687–729, 1734, 3171, 3502, 3512, 3608–3683, 3890, 4208, 9276, 12,674–12,678, 13,423, 13,509–13,511, 13,627.
For mining, in University College, 727–729.
In America, 1447, 1560–1562.
At Oxford University, 3171, 3283, 3309–3312, 3383, 3501–3528, 3789–3852, 3890, 3965, 4080, 4144–4148, 4193, 4209.
Parliamentary influence on collegiate, 3608, 3659–3671, 3683.
Book on, by Rector of Lincoln College, 3683.
At Cambridge University, 4243, 4332–4404.
At Edinburgh University, 9276.
At Queen's College, Belfast, 13,275–13,279, 13,283.
At Catholic University of Ireland, 13,423.
Utilization of existing, 13,509, 13,511, 13,627.

ENDOWMENTS AND PARLIAMENTARY GRANTS.
Universities of Oxford and Cambridge, App. VI., Vol. I., *9–19*.

ENGINEERING.
At King's College, 687, 6885–6996, 7092, 7585, 7699.
Royal School of Mines' courses desirable for, 750.
In France, 1598–1600.
Endowment for, 1604, 1613, 1615.
At Glasgow University, 2773–2839, 9504–9608, 9867.
Objection to technical instruction, except with regard to, 2793–2820, 2842–2859.
At Oxford University, 3373–3425, 3897–3938.
At Cambridge University, 4395–4476, 4663, 4669, 5109, 5207–5243.
Importance of practical work for, 5244, 5247, 5252.
Proposal to include, in a high science school at Bristol, 6428–6431*a*.
Insufficiency of demand for education in, 6880.
In applied science department at King's College, 7092.
At University College, 7170, 7842.
At Newcastle College of Science, 8764, 9153.
At Durham University, 8777.
Apprenticeship in, 9178–9191.
Objection to college workshops for students of, 9186–9191.
Unscientific persons engaged in, 9205.
At Edinburgh University, 9276–9450.
State of profession of, 9595.
Importance of physical laboratories for, 10,683.
Scientific ideas in relation to, 10,971–10,975.

ENGINEERING—*cont.*
In Dublin University, &c., 12,831–12,881.
Cooper's Hill Engineering College, 12,864–12,879.
At Queen's College, Galway, 13,138–13,181.
At Queen's College, Cork, 13,221–13,247.
At Queen's College, Belfast, 13,266–13,272, 13,326.

ENGINEER OFFICERS.
As visitors for science schools, 7, 5973.

ENGINEERS.
Demand for, in United States, 1555–1557.
American engineers, 1558.
Education of, &c., 1558, 1580–1744, 9470, 11,342.
Foreign education of, 1580–1582.
English pupils of, preferable, 1581, 1594, 1597.
Colleges in lieu of apprenticeship for, 1584–1604.
Indian examination for, 1662.
Education of viewers in offices of, 8824.
Difficulties of students articled to, 8829.
Geology and mineralogy desirable for, 9470.
Want of interest in education shown by, 9595.
Tendency of, to discountenance small scale trials, 11,342.

ENGLAND.
Geology best taught in, 590.
Progress of Geological Survey in, 754.
Engineers of, preferable to foreign, 1581, 1594–1597.
Drawing in, 1615–1629, 1704–1706.
Competition of foreign engineers with, 1693–1695.
Miners of, compared with those of France and Germany, 2400–2402.
Education of viewers in north of, 2544–2549.
Ventilation of mines in, 2639–2645.
Education in science in, as affecting science at Oxford University, 3577.
Crystallographic knowledge in, 4103–4105.
Compared with Germany, &c., as to science, 7384–7387, 7403.
School teachers in, and in America, 8357.
Metallurgical teaching wanted in, 9155–9158.
More scientific colleges on the continent than in, 9236.
See *Great Britain.*

ENGLAND, JOHN, ESQ., M.A.
Evidence of, 13,233–13,249. Analysis of Evidence, Vol. II. App. page *184.*

ENGLISH HISTORY.
Objection to Government syllabus requirement for, 7950.

ENGLISH LANGUAGE.
Instruction in, under East Lancashire Union, 2145, 2150, 2155, 2184.

ENTOMOLOGY.
Lectures on, might be given at British Museum, 6593, 6613, 6641, 6824.

ESTIMATES.
For science, 7–13, 143, 5953, 6065–6070.

ETHNOLOGY.
Promotion of, by Smithsonian Institution, 1407, 1488, 1502.
In Oxford Museum, 3709, 3713.
Lectures on, desirable at British Museum, 6593, 6613, 6641.

EUCLID.
Use of, at Oxford, &c., 3912, 4267, 5922, 6370.
Objection to, 6084, 8140–8143.

EVENING CLASSES.
Scientific instruction in, 149, 1881–1911, 1957, 2412–2418, 2726–2731, 5809–5812, 5903, 5965, 6119, 6482, 6883–7031, 7251, 7294, 7583–7691, 8480–8525, 9208–9235, 9509–9532, 9643–9657, 9811, 9966–10,004.
In Cornwall, 2412–2414.
In Yorkshire mechanics' institutes, 6119.
Wanted at Glasgow University, 2726–2731.
At King's College, 6883–7119, 7583–7691.
Wanted at Newcastle College of Science, 9208, 9229–9235.
At Elswick, 9229–9235.

EVENING EXHIBITIONS.
At British Museum, 6575–6579, 7469–7511.
In new natural history museum at South Kensington, 6604, 6845, 7474.
At Museum of Practical Geology, 9107, 13,819–13,831.
At Edinburgh Museum of Science and Art, 10,290–10,298.

EVENING SCHOOLS. See *Science Classes.*

EXAMINATION PAPERS.
Of Science and Art Department, 6, 13, 17, 36, 51–53, 211, 216–219, 239, 252–349, 569–634, 763, 766, 805–809, 5973, 6084, 2298–2375, 4882–4937.

EXAMINATIONS IN SCIENCE, &c.
Of Science and Art Department, 2–32, 142–164, 217–235, 252–343, 391, 569–632, 762–828, 1814–1816, 1902, 2153–2360, 4882–4931, 5898–5952, 6099, 6150–9016, 11,963–11,969.
At Royal School of Mines, 369–558.
For seamen, 865–875.
Under Board of Trade, 871, 875.
At School of Naval Architecture, 1002, 1038–1081.
In America, 1437.
For Indian Telegraph, 1585, 7794.
Carlsruhe system of, 1662.
Indian Civil Service, 1662, 5230–5238, 7873–7877.
At navigation schools, 2054–2112.
At Glasgow University, 2678–2866, 9917–9928, 9506–9567.
At Oxford University, 2979–3019, 3074, 3088, 3172–3204, 3220, 3254, 3275–3573, 3608–3614, 3687, 3699–3732, 3755–4084, 4129–4131, 4166–4168, 4194, 4214, 4826–4848, 13,700, 13,779–13,814.
Cramming for (see *Cramming*).
At London University, 3755, 5870, 7782–7835, 7865–7887.
At Cambridge University, 4235–4485, 4566–4568, 4635–4641, 4661–4665, 4959, 4974, 4983, 5024–5182, 5265–5278, 5312–5315, 5376–5578, 10,496–10,539.
Competitive, 4531, 10,741–10,758, 12,869–12,879, 13,445.
Middle-class local, 4597–4609.
For Whitworth scholarships, 5247, 5252.
In German universities, 5792.
Of Education Department, 6141–6147, 7950–7963.
At King's College, 6880–7127, 7599–7625.
For British Museum appointments, 7516.
Individual examination in schools, 8083.
At Newcastle College of Science, &c., 8764, 8783.
At Durham University, 8780–8782.
Of Society of Arts, 9002–9052.
At Edinburgh University, 9264–9461.
At St. Andrew's University, 9637–9787.
At Anderson's University, 9973–10,036.
Of Civil Service Commission, 11,678–11,876.
At Dublin University, 12,730–12,956.
At Queen's College, Galway, 13,139–13,178.
At Cooper's Hill College, 13,158–13,164.
At Queen's College, Cork, 13,201–13,225.
At Queen's University, Ireland, 13,207, 13,213.
At Queen's College, Belfast, 13,275–13,279.
At Catholic University of Ireland, 13,427, 13,484.

EXAMINATIONS (SCIENCE), MAY 1870.
Confidential Memorandum with regard to the Preparation of the Papers for the, App. III., Vol. I., page *6.*

EXAMINATIONS.
Observations on Cramming for, by Professor Hennessy, App. VI., pp. *25–27.*

EXAMINERS IN SCIENCE, &c.
Of Science and Art Department, 7, 13, 24, 150–239, 252–327, 567–635, 4611, 4882–4937, 6059, 6084, 6314–6317, 6469.
Assistants to, 594–599.
Distinguished men for, 4366, 4430, 4438.
Of Society of Arts, 9043.

EXAMINERS UNDER THE SCIENCE AND ART DEPARTMENT.
Reports from, App. XVII., Vol. I., pp. *48–56.*

EXETER COLLEGE (OXFORD).
Promotion of science, &c., at, 3840, 3980–4089.

EXHIBITIONERS OF THE ROYAL SCHOOL OF MINES.
Sent by Government, after examination, 661.

EXHIBITIONS.
For Yorkshire College of Science, 6149.
For Homerton College, 8116, 8124,
For elementary and secondary schools, 8219–8265.
See *Fellowships* and *Scholarships.*

EXHIBITIONS (MUSEUM). See *Evening Exhibitions.*

EXPENSES.
Grant in aid of, for laboratories, &c., 766, 768.
For chemical experiments, &c., 5717–5894.
See *Grants in aid of Science. Income and Expenditure.*

EXPERIMENTAL INSTRUCTION.
Teachers' examination papers show absence of, 806-809.

EXPERIMENTAL PHILOSOPHY.
Professorship of, at Newcastle College of Science, 8766.

EXPERIMENTS.
Want of funds, &c., for, 766, 5867.

EXTRA PROFESSORS.
In German universities, 1554, 2941–2946.

F.

FACTORIES' ACT.
Definition of school age by, 315.

FALCONER, DR.
On having a botanical collection in London, 7739, 7740.

FACULTIES.
Of Medicine, Arts, &c., 2656, 3358–3360.
In Scottish Universities, 9858–9883.
In Glasgow University, 9867.
In Anderson's University, 9942.
In Queen's College, Belfast, 13,254.

FARISH, PROFESSOR.
Lectures by, 4657, 4668, 4690.

FARRER, T. H., ESQ.
Evidence of, 12,620–12,679. Analysis of Evidence, Vol. II. App. page *205*.

FAVERSHAM.
Good organisation of schools at, 198.

FEES.
Under Science and Art Department, 2, 1229, 2155, 5954, 5960, 6432-6452.
At Royal School of Mines 379–533.
At School of Naval Architecture, 1061, 1130.
At Oldham science schools, 1860.
In trade schools, 2021-2023.
In Plymouth Science School, 2097–2133.
Under East Lancashire Union, 2155.
In Glasgow University, 2788–2790.
In Oxford University, 3230–4078.
At College of Chemistry, 5670–5841.
In Bristol Trade School, 5945, 6355, 6383, 6401.
In Yorkshire mechanics' institutes, &c., 6141–6154.
In Owens College, 7258–7263, 7364.
In Germany, 7384, 7389.
In St. Mark's College, 7988–7995.
In Huddersfield Mechanics' Institute, 8880, 8986.
Of Students and the Payments on Results in Science Schools under the Science and Art Department, Comparison of the, App. XVIII., Vol. I., p. *56*.
See *Income and Expenditure*.

FELLOWSHIPS.
At Oxford University, 3213-4135, 4188–4217, 4829–4837, 12,677, 13,737, 13,745.
Connection of, with chairs, for retiring allowances, 3392.
As affecting schools, 4218.
At Cambridge University, 4245–5296, 5478–5648.
For clergymen, through science, 4513–4516.
Objection to diminishing number of, 4838–4840, 4860.
Fund of, might be appropriated to University professors, 5047.
Examinations for, essential, 5064-5066.
Should not be given to inferior candidates, 5271.
Should be awarded for scientific research, 5880, 9515, 10,767–10,777, 10,929, 10,954–10,956, 11,769, 11,770, 11,826–11,830, 12,677.
Fair distribution of, for science, should be made by universities, 7881, 7897.
At Edinburgh University, 9269–9309.
At Dublin University, 12,750–12,762, 12,855, 12,883, 12,894.
Unsatisfactory application of revenues of, 13,571–13,573 13,585.
At the several Colleges in the Universities of Oxford and Cambridge, Information respecting, App. VI., Vol. I., pp. *25–31*.

FIELD CLUBS. See *Natural History Clubs*.

FINE ARTS.
At University College, 7133, 7142.

FISHERIES.
Control of, by Board of Trade, 12,622–12,631.
Meteorology as affecting, 14,303.

FITZ ROY, ADMIRAL.
Services of, to physical meteorology, 13,863–14,467.

FLINTSHIRE.
Desire of mining proprietors in, for geological maps, 754.

FLOWER, PROFESSOR, F.R.S.
Evidence of, 6844–6875. Analysis of Evidence, Vol. II., App. page *137*.

FOREIGN ARTIZANS. See *Artizans* (*Foreign*).

FOREIGN STUDENTS. See *Students*.

FOREIGNERS.
English engineers preferable to, 1581, 1594–1597.
Engagement of, in smelting works, 2367, 2369.
As professors at Oxford, 3606.

FORFARSHIRE.
Science examination papers by ploughmen from, 11,963–11,969.

FOSSILS.
Children should be taught geology by, 600.
Department candidates in geology show little knowledge of, 602, 615.
Instructors' collections of, 5915.

FOSTER, DR. MICHAEL.
Lectures by, at South Kensington, 40, 2155.
As prælector in physiology at Cambridge, 4996–4998, 5020.

FOSTER, G. CAREY, ESQ., B.A.
Evidence of, 7779–7863. Analysis of Evidence, Vol. II. App. page *152*.

FOSTER, P. LE NEVE, ESQ., M.A.
Evidence of, 9001–9054, and Vol. II. page 369. Analysis of Evidence, Vol. I. App. page *127*.

FOWLER, REV. T., M.A.
Evidence of, 13,658–13,752. Analysis of Evidence, Vol. II. App. page *106*.

FRANCE.
Chemistry in, and in Britain, 832–834, 5866, 11,053.
Teaching of industrial applications of science in, 1173.
Government aid to science in, 1182.
Endowments in, for science teachers, 1229.
"Répétiteurs" in, 1268.
Professors in, 1268, 1507–1553, 10,136–10,185.
Tendency to extravagant engineering in, 1598–1600.
Linear drawing of workmen in, 1615, 1707.
Objection to "Government science" in, 1767.
Schools for workmen in, 2377.
Imperfect system of education in, 3856.
More laboratories in, than in England, 5873.
Botanic Garden of Paris, 7757.
Approval of method of teaching geometry in, 8140.
Where required in, scientific men and science schools are found, 9158.
Muséum d'Histoire Naturelle, Paris, 10,136–10,139, 10,185–10,189.
Great attention paid to meteorology in, 10,339, 12,514.
Paid academy of science in, 10,521, 11,035–11,038.
Vigorous promotion of science in, 10,697.
Science considered a profession in, 10,923.
Scientific research by private investigators in, 11,064, 11,105.
Ahead of England in naval architecture, 11,304–11,306.
State observatory for solar research in, 11,364, 11,479, 11,528.
Conservatoire des Arts et Métiers, Paris, 11,656.
International Metric Commission, Paris, 11,656, 11,736–11,746.
Metric system in, 11,656, 11,673.
Scientific societies in, 11,833.
Trained natural history collectors in, 12,126.
Institutions in, for teaching agriculture, 12,533.
Engineering students in, 12,876.
Meteorological Department in, 13,957, 14,449, 14,454–14,456.
See *École des Mines, &c., Paris*.

FRANKLAND, DR.
Evidence of, 758–835, 5667–5896, 11,053–11,108. Analyses of Evidence, Vol. I. App. page *78*, and Vol. II. App. page *195*.
Lectures by, &c., 40–47, 365, 415, 516–518, 943, 980–982, 1080, 2461, 2473–2488.

FRASER, RIGHT REV. J., D.D., LORD BISHOP OF MANCHESTER.
Evidence of, 8287–8359. Analysis of Evidence, Vol. I. App. page *121*.

FREE-HAND DRAWING.
Errors of Professor Jenkin in statistics of, 6081.
Efforts of Science and Art Department to encourage, 6082.
See *Drawing*.

- Free Schools.
  - In Oldham, instituted by Mr. Platt, 1825.
  - System of, advocated, 1871, 1874, 1930.
- Freiberg Mining Academy.
  - Teaching at, &c., 1341–1345, 1377, 2324, 2368, 2456.
- French Language.
  - In connexion with science, 7364.
- Froude, W., Esq., F.R.S.
  - Evidence of, 11,274*a*–11,353. Analysis of Evidence, Vol. II. App. page *196*.
- Funds. See *Cost, Income, &c.*

G.

- Galton, Capt. D., C.B.
  - Evidence of, 12,961–13,033. Analysis of Evidence, Vol. II. App. page *207*.
- Gas.
  - Scientific standards for, &c., 11,656–11,718, 12,631, 12,637.
- Gatty, Mr.
  - Value of knowledge of chemistry to, 824.
- Geikie, Professor A., F.R.S.
  - Evidence of, 9463–9503. Analysis of Evidence, Vol. II. App. page *168*.
- Geodesy.
  - Honours in, at Glasgow University, 9506.
- Geographical Society. See *Royal Geographical Society.*
- Geography.
  - Students of mineralogy should understand, 2460.
  - In primary schools, 4616–4621, 7703, 8584–8598.
  - Physical, essential to study of geology, 7629, 7630.
  - Is fairly taught in rural schools, 8316.
  - Promotion of geographical science, 12,548–12,619.
  - See *Physical Geography.*
- Geological Maps, Sections, and Specimens.
  - Practical value of, 626.
  - Want of room for exhibition of, in Museum of Practical Geology, 670.
- Geological Society of Edinburgh.
  - Members, funds, &c., 12,425–12,538.
  - Petition of the Council of the, App. XV., Vol. II., p. *70*.
- Geological Society of Ireland.
  - Connexion between, and Dublin University, 12,954.
- Geological Survey of the United Kingdom.
  - Foundation, valuable services, collections, want of accommodation, &c., 51–53, 76, 362–757, 2333–2493, 5848, 5985, 6060, 7597, 9483–9490.
- Geological Surveys in America.
  - State appropriation for, 1438–1442.
- Geology.
  - Government aid to, 115, 11,354, 11,482.
  - At Royal School of Mines and Museum of Practical Geology, 363, 365, 526, 640–724, 6108–6111, 13,818.
  - Under Science and Art Department, 569–576.
  - Teaching of, to children, 605, 613.
  - Should be practically learned, 626–629.
  - Defective teaching of, in Scotland, 686.
  - At Cambridge University, 710–712, 4265–4267, 4453, 4985, 5081, 5108, 5157, 5193, 5237, 5310–5317.
  - Specials chairs for, desirable in Scotland, 2741–2743.
  - Dr. Buckland's collection, &c., 2880, 2886, 2912.
  - At Oxford University, 3172–3200, 3781, 3817, 4096–4143.
  - Crystallography an essential part of, 4100, 4105.
  - Importance of mineralogy to, 4117.
  - In proposed science college, 5953, 5999.
  - At British Museum, 6493, 6578, 6593, 6613, 6641, 6683, 7220, 7739–7740, 7764.
  - In new natural history museum at South Kensington, 6822, 6847–6852, 7205–7210.
  - At King's College, 7018–7030, 7583–7680.
  - Instruction in, could not be self-supporting, 7679.
  - Not a subject for schools, 7703.
  - At Newcastle College of Science, 8766, 9153.
  - Combination of professorship of, with biology, 8790.
  - At Edinburgh University, 9463–9503.
  - Foundation of chair of, by Sir R. Murchison, 9464.
  - Scottish Geological Survey, 9483–9488.
- Geology—*cont.*
  - Edinburgh as a locality for teaching, 9502.
  - At Glasgow University, 9506–9868.
  - Encouraged by Royal Society of Edinburgh, 12,482.
  - At Dublin University, 12,828–12,830, 12,852.
  - At Queen's College, Galway, 13,155.
  - At Queen's College, Belfast, 13,252, 13,316–13,347.
  - At Catholic University of Ireland, 13,428–13,431.
- Geometry.
  - Under Science and Art Department, 2199–2203, 6082–6088.
  - For students of mineralogy, 2460.
  - At Oxford University, 3470–3476.
  - Objections to Euclid, 5922, 8140–8143.
  - At Bristol Trade School, 5945–6370.
  - Teaching of, to carpenters and joiners, 6085.
  - In Homerton College, 8110.
- German Language.
  - Study of, in connexion with science, 3722, 7364.
- German Universities.
  - Performing a piece of work for degrees in, 2833–2836.
  - Extraordinary professors in, desirable for Oxford, 2941.
- Germany.
  - Chemical research, &c. in, 832–834, 5866, 7391, 10,061–11,103.
  - Failure in, in teaching applications of science in schools, 1173.
  - Government aid to science in, 1182–1316.
  - "Privat-docenten" in, 1268, 7846.
  - Germans in America, 1554, 1557.
  - Professors in, 1554, 2941–2946, 7846, 10,099–10,189, 11,392–11,394.
  - Better engineers in Britain than in, 1584.
  - Drawing by workmen in, 1615, 1707.
  - Schools for workmen in, 2379.
  - Colleges in, 2435.
  - Subjection of professors in, to public opinion, 3250.
  - Scientific investigation in, 3593, 11,053–11,103, 11,809, 12,471–12,473.
  - Gymnasia, realschulen, and realgymnasia in, 3742–3745, 5210–5223, 5273–5275.
  - Examination of students in, 3828.
  - Professor "extraordinarius," 3834.
  - Evil of separate literary and scientific culture in, 3855.
  - In universities of, literature, not science, is the attraction, 3897.
  - Crystallography in, 4104.
  - Science degrees in, 5792, 7351.
  - Good laboratories in, 5873, 10,822–10,876, 11,809–11,811.
  - University dissertations in, 5876–5889, 11,815–11,819.
  - Introduction of science into universities of, 7255.
  - Science teaching in, compared with England, 7384–7406.
  - Relation between universities, schools, and Government in, 7389–7392.
  - Seminaria in, 7389.
  - Chemical schools of, 7391.
  - Peculiar system of teaching in, 7402.
  - Employment of chemists from, 7407.
  - University system of, a model for England, 7430.
  - Museums open on Sunday in, 7508.
  - Museums in, 7508, 10,083–10,184.
  - Approval of system of "Privat-docenten" of, 7846.
  - Science schools, &c. in, are found where requisite, 9158.
  - Local collections connected with schools in, 10,304.
  - Meteorology in, 10,339.
  - Promotion of science in, 10,846, 11,388–11,394, 11,833–11,844, 12,197, 13,054–13,101.
  - Occupation for students of biology in, 10,921–10,924.
  - Position of science in, 11,388–11,394.
  - Teaching weights and measures in, 11,656.
  - Metric system in, 11,656, 11,673, 11,714.
  - Hardly any patent laws in, 11,781–11,788.
  - Physiology in, 12,294–12,333.
  - Appointments for scientific students in, 12,302, 12,334.
  - Passing poor scholars into higher schools in, 12,460–12,465.
  - Agricultural science in, 12,530.
  - Centralization of administration of science in, 12,681.
  - Scientific instruction in: communication from Professor Hofmann, App. XVII., Vol. II., pp. *71*, *72*.
- Giessen University.
  - School of chemistry in, 7391.
- Gladstone, The Right Hon. W. E., M.P.
  - On defective management of national museums, 9064.

GLAISHER, JAMES, ESQ., F.R.S.
Evidence of, 14,497–14,553. Analysis of Evidence, Vol. III. App. page *12*.
Meteorological work of, 14,075–14,090, 14,173–14,197. See *Registrar-General.*
Correspondence with the Treasury relative to certain Meteorological returns furnished to the Registrar-General by Mr. Glaisher, App. II., Vol. III., pp. *2–5*.

GLASGOW.
Technical schools at, 2302, 9601.
Mining school at, 2499, 2626, 9601.
Promotion of science in, 2499, 2580, 2626, 9601, 10,005–10,058.
Secular School at, 10,005–10,014.

GLASGOW UNIVERSITY.
Scientific instruction in, 2653–2863, 4848, 6001, 9504–9614, 9727–9933, 12,208.
Faculties in, 2656.
Professors in, 2658–2863.
Scholarships in, 2661–2664.
Students in, 2666, 2684, 4848.
Examinations in, 2678.
Degrees in, 2682, 2837–2841.
Interest taken by, in Scotch Education Bill, 2686.
Government grants, &c. for, 2688–2692, 2783–2787.
Laboratories in, 2698–2712, 2760–2768, 12,208.
No instruction for artizans or ladies in, 2726–2732, 2791.
Engineering at, 2773–2776, 9504–9569.
System of teaching in, 2863.
Amount purposed to be expended on, 6001.
Natural history, geology, &c., at, 9569–9614.
Assistants, class expenses, &c., at, 9727–9733.
Statement with regard to endowments and Parliamentary grants of, App. V., Vol. II., page 7.

GLASNEVIN.
Botanic Gardens at, 9055–9072.

GOODEVE, PROFESSOR.
Lectures by, 365.

GORE, G., ESQ., F.R.S.
Evidence of, 10,778–10,919. Analysis of Evidence, Vol. II. App. page *193*.
Communications from, on the Advancement of Science; on a National laboratory for scientific research; and on Plans for encouraging original scientific research, App. X., Vol. II., pp. *33–41*.

GÖTTINGEN.
Introduction of science into University of, 7255.
Scientific instruction at, 7384, 7389.

GOVERNMENT.
Connection of, with Royal School of Mines and Geological Survey, 372–755.
Aid of, to science (see *Grants in aid of Science*).
Royal Society, Mr. Cole, &c. consulted by, 1209–1212.
Engineer officers, &c. under, 1585–1588, 1604–1612.
Aid of, for preliminary examination in Edinburgh University, 1654.
Science council for, 1658–1661, 2693–2697, 3132, 3149, 3541, 7436–7439, 10,522, 10,543, 10,559, 10,661–10,777, 11,281–11,340, 11,972–12,137, 12,552–13,031, 13,514–13,647.
Indian appointments of, 1662.
Might establish mining schools, &c., 1768, 2448, 2455.
Stipend of, withdrawn from Bristol Mining School, 2499–2504.
Could not support all mining schools, 2578.
Taxing coal or wages by, for scientific education, 2619–2623, 2648–2650.
Connection of, with Glasgow University, 2686–2692.
Royal Society as scientific adviser of, 3541, 7223–7238, 9555–9558, 10,543–10,559, 10,930–10,941, 11,199–11,239.
State continental technical schools, 5211, 5275.
Might aid scientific investigations, publication of reports, &c., 5222.
Connection of, with Kew, 6689–6778, 7240.
Connection of, with South Kensington, 6703–6778.
Connection of, with College of Surgeons, 6806–6813, 6874.
Connection of, with British Museum, 6806–6813, 7221, 7454–7550.
Aid to scientific societies by, 6838–6842, 10,443–10,541.
No connection between, and King's College, 6888–7063 7100, 7642, 7693–7710.
No connection between, and University College, 7132 7181*a*, 7840–7859.
Officer of, for science, essential, 7222, 7233–7238.

GOVERNMENT—*cont.*
Aid of, to academies, &c., in Germany, 7389, 7406, 10,083–10,114, 11,392–11,394.
Scholarships of, 7417.
Physical laboratories have a claim on, 7418.
Should found professorships, 7425–7429.
Cost to, of science colleges, 7435.
Aid of, to voluntary institutions, 7696, 13,508–13,513.
Connection of, with Saint Mark's College, 7992.
Newcastle College of Science has a claim on, 8773–9253.
Connection of, with Edinburgh University, 9278–9392.
Aid of, desirable for research, 9515, 9554–9560, 10,492–10,494.
British Association as adviser of, 9555–9558, 11,199–11,239.
Should aid chair of geology at Glasgow, 9572, 9611.
Connection of, with St. Andrew's University, 9716–9790.
Aid of, to Anderson's University, 10,000–10,016.
Should aid museums raised by private contributions, 10,173.
Government scientific institutions, 10,315.
Should aid meteorology, 10,329–10,349, 14,031–14,553.
Should establish observatories, laboratories, &c., 10,441–10,488.
Approval of the Government Grant Committee, 10,515.
Aid of, to astronomy and chemistry, &c., 10,519, 10,520.
Assistance from, would encourage local effort, 10,667.
Should promote biology, 10,920–10,961.
Aid of, to circumnavigation expeditions, &c., 10,930–10,935.
Methods by which science could be promoted by, 11,117–11,136.
Claim on, of Scottish Meteorological Society, 11,243–11,256, 12,379–12,410.
Promotion of science by, a public advantage, 11,580–11,654.
Apathy of, in relation to standards, 11,656, 11,685.
Should co-operate with foreign governments for science, 11,781–11,788.
Investigations of iron, fuel, &c. should be undertaken by, 11,925–11,962.
Aid to science by, wanted in Scotland, 12,420–12,457.
Relation of, to Royal Geographical Society, 12,548–12,608.
Utilization of endowments before application to, 13,509.

GOVERNMENT GRANT COMMITTEE (ROYAL SOCIETY).
Work, funds, &c. of, 1284–1291, 1391, 2693–3543, 5892–5894, 11,354–11,369.

GOVERNMENT GRANT TO THE ROYAL SOCIETY IN AID OF SCIENTIFIC RESEARCH.
Correspondence respecting the, App. XI., Vol. II., pp. *41–62*.

GOVERNMENT GRANTS. See *Grants in aid of Science.*

GOVERNMENT SURVEY EXPEDITIONS. See *Survey Expeditions.*

GRANT, R., ESQ., LL.D.
Evidence of, 12,195–12,291. Analysis of Evidence, Vol. II. App. page *202*.

GRANTS IN AID OF SCIENCE.
Under Science and Art Department, 2–291, 579–582, 766–804, 1330–1337, 2028–2034, 2174–2177, 2300, 6131, 6432–6452.
To Scotch universities, 245, 13,620.
For Geological Survey, 751.
Of continental mining academies, 2463.
To evening schools, 6451.
In Germany, 1194, 1314–1316.
Of Royal Society, 1573, 10,318–10,734, 10,898–10,907, 11,109–11,239, 11,570–11,573, 11,890, 11,995, 12,213–21,260, 12,434–12,547, 13,135, 13,527, 13,652.
To Edinburgh University, 1645–1647, 1676, 9464.
Should be made for laboratories, training colleges, &c., 2716–2725, 8478, 10,567–10,673, 12,302–12,337.
To Glasgow University, 2765–2772.
For Owens College, 2785–2787, 7266–7318.
To Universities in Scotland, 2869.
To Kew, 3109–3111, 11,354–11,369, 12,190–12,194.
Should be given to observations on rainfall, 3113.
Minister wanted to advise respecting, 3123–3150.
Of Oxford University, 2881–4037.
None given to Yorkshire Union or Yorkshire Board of Education, 6120.
Science in training colleges might be encouraged by, 8284, 8268.
Want of, at Anderson's University, 10,047.
By British Association, 10,318.
For meteorology, 10,329, 14,047, 14,052.
On the continent, 10,563.

- Grants in aid of Science—*cont.*
  - For deep-sea researches, 10,933–10,935.
  - None exist for reward of discoveries, 11,179–11,182.
  - For investigations in naval architecture, 11,300, 11,316.
  - For publishing meteorological observations, 11,354–11,445.
  - For agriculture, by Mr. Bennet Lawes, 11,575.
  - Should be made to India, for science, 11,893.
  - For Scottish Meteorological Society, Edinburgh Geological Society, &c., 12,379–12,410, 12,446–12,530.
  - For survey expeditions, 12,549–12,551.
  - Of Royal Geographical Society, 12,588–12,601.
  - Of Meteorological Office, 12,639–12,668.
  - Of Royal Irish Academy and Royal Dublin Society, 12,781–12,801.
- Gray, Dr.
  - His zoological catalogues, &c., 6522, 6593, 6604.
- Great Britain.
  - Before opening of Jermyn Street Museum, mineral wealth of, was unrepresented, 2315.
- Great Exhibition.
  - Dissections of animals in, 2966–2970.
- Greek.
  - Study of, for science students, &c., 2973–3274, 3414, 3578–4875, 5014–5584, 7092, 9292, 9711, 13,221.
  - For university degrees, 3578, 3754, 3756, 3897–3974.
  - At Oxford University, 3754, 3756, 4018, 4128, 4855–4875.
  - At London University, 3755.
  - At Cambridge University, 4635–4641, 5014, 5569–5584.
  - At King's College, 7092–7094.
  - At Edinburgh University, 9292.
  - At St. Andrew's University, 9711.
  - At Queen's College, Cork, 13,221–13,225.
- Greenwich Hospital.
  - Picture Gallery of, 9055, 9063–9066.
- Greenwich Hospital School.
  - Teachers of navigation in, 848, 858, 860.
- Greenwich Observatory.
  - Its board of visitors, 6693–7489, 10,349, 12,138–12,184, 12,253.
  - Meteorological observations, &c., at, 10,341, 10,490–10,492, 11,403–11,526, 13,912–13,915, 14,123–14,159.
  - Might undertake physics of astronomy, 10,477–10,488, 11,625, 13,124, 14,152.
  - Great amount of printing for, 10,488.
  - Under the Admiralty, 10,524–10,528.
  - Established for astronomy and navigation, 10,524–10,528.
  - As a State institution, 11,416.
  - Should be controlled by a council of science, 12,563.
  - Observations on atmospheric electricity at, 14,021, 14,051, 14,097.
  - Photographic observations at, 14,023, 14,500–14,547.
- Greenwood, J. G., Esq., B.A.
  - Evidence of, 7250–7362. Analysis of Evidence, Vol. II. App. page *159*.
  - On German schools, 3718, 3742–3746.
- Grove, The Hon. Mr. Justice.
  - Letter from, touching the Advancement of Science, App. XVI., Vol. II., page *71*.
- Gun Cotton.
  - Manufacture of, 5683.
- Gunnery.
  - Importance of scientific methods in, 11,280, 11,303.
  - Models of, wanted at Cambridge University, 4395.
- Günther, A., Esq., F.R.S.
  - Evidence of, 10,079–10,201. Analysis of Evidence, Vol. II., App. page *142*.
- Guthrie, Professor.
  - Lectures by, 40, 365.
- "Gymnasia," "Realgymnasia," and "Real Schulen."
  - In Germany, 1945, 3742–3745, 5210–5223, 5273–5275. See *Practical Schools.*

H.

- Haley Hill Working Men's College.
  - Technical classes at, 8891.
- Halifax.
  - Technical classes at, 8891–8894.
- Hall for Students. See *Lodgings for Students.*
- Hampton Court.
  - Picture galleries at, 9055–9066.
- Hansard, Rev. Septimus.
  - On national museums, Vol. II. page 369.
- Harbours.
  - Scientific matters relating to, 12,622–12,631.
- Harrow School.
  - Science teaching, &c. at, 4606–4633.
- Harvard University (U.S.)
  - Scientific teaching at, 1458–1460, 1519, 1558. See *Massachusetts.*
- Harvey, A., Esq.
  - Evidence of, 10,059–10,078. Analysis of Evidence, Vol. II. App. page *177*.
- Hawes, Sir Benjamin.
  - Committee of, 9089.
- Heads of Colleges.
  - At Cambridge, 4377–4379, 4727–4729, 5554–5556.
- Health.
  - Scottish Meteorological Society's observations on, 12,505, 12,528.
- Heat.
  - Instruction in, at Cambridge University, 4577–4580.
  - Might be studied by boys, 4603.
  - Instruction in, at University College, London, 7823.
- Heddle, M. F., Esq., M.D.
  - Evidence of, 9759–9790. Analysis of Evidence, Vol. II. App. page *180*.
- Heidelberg University.
  - Science in, 7255, 7296–7402.
- Henfrey, Professor.
  - On having a botanical collection in London, 7739.
- Hennessy, H., Esq., F.R.S.
  - Evidence of, 13,481–13,506. Analysis of Evidence, Vol. II. App. page *187*.
  - Observations by, on cramming for examinations, App. VI., Vol. II., pages *25–27*.
- Henry, Professor Joseph.
  - Evidence of, 1403–1575. Analysis of Evidence, Vol. II. App. page *188*.
  - Appendix to the evidence given by (Vol I., pages 84–92), App. I., Vol. II., page *1*.
- Henslow, Professor.
  - Ipswich Museum arranged by, 3103.
  - His school in Suffolk, 8303, 8319.
- Herbaria.
  - For teaching of botany, 4922.
  - As affecting Kew, British Museum, and South Kensington, 12,987, 13,005–13,025.
- Hereford Bluecoat School.
  - Efficiency of, 8303–8310.
- Herpetology.
  - Lectures on, might be given at British Museum, 6593–6642.
- Herschel, Sir John.
  - Elementary books by, 3147.
- Heywood, James, Esq., F.R.S.
  - On national museums, Vol. II. page 369.
- Highland Society.
  - Chemical analyses for, 9838.
- Histology.
  - At Glasgow University, 9601.
- History.
  - Importance of, 3097, 8598.
  - At Oxford University, 3897–3916.
- Hofmann, Dr.
  - Connection of, with College of Chemistry, 88–90, 2473–2482, 5667–5682.
  - Important researches of, 5682.
  - Report of, on German laboratories, 7385.
  - Communication from, on scientific instruction in Germany, App. XVII., Vol. II., pages *71*, *72*.

Holland.
Birds. &c. in Leyden Museum, 10,140–10,142.
Exertions by Government of, to get natural history specimens, 10,143.

Home Office.
Mining inspectors appointed by, 2459.

Homerton Training College.
Science teaching, &c., at, 8100–8155.

Honours.
Under Science and Art Department, 261, 282, 573, 766, 770, 8949–8954.
In Plymouth Science School, 2064, 2072.
At Oxford University, 3172–4199.
At Cambridge University, 4231–5205.
At Glasgow University, 9506, 9861.

Hooker, Dr.
Evidence of, 6657–6768, 12,138–12,194. Analysis of Evidence, Vol. II. App. pages *135*, *202*.
On Kew, British Museum, &c., 4366, 7240, 7718–7756.

Hope Chemistry Prize.
At Edinburgh, 9385.

Hospitals.
Cambridge medical students should attend, 4423.
Erected by King's College, for clinical teaching, 7038.

Hoyle and Sons.
Advantage of a knowledge of chemistry to, 822–825.

Huddersfield.
Mechanics' Institute, &c., at, 8842–9017.
Classes for chemistry of dyeing &c. at, 8891–8894.
Literary and Scientific Society of, 8983.
Field club at, 8983.
Society of Arts' examinations at, 9002.

Hull.
Navigation school at, 845–864.
Difficulty of procuring a science teacher at, 2019, 2030, 2046.
Young People's Institute science classes at, 6122.

Humphry, G. M., Esq., M.D.
Evidence of, 4356–4526. Analysis of Evidence, Vol. II. App. page *111*.

Hunterian Museum (Royal College of Surgeons).
Teaching, &c., at, 6587–6874, 11,537–11,567.
Professor Flower's lectures at, 6802–6813.
A burthen to College of Surgeons, 6806–6808.
Objection to moving, to South Kensington, 6854–6868.
State physiological laboratory should be connected with, 11,537, 11,566.

Hunterian Museum (Glasgow).
Want of funds, &c., at, 9572–9598, 9888–9916.

Huxley, Professor.
Evidence of, 251–358. Analysis of Evidence, Vol. I. App. page *67*.
His lectures, text-book, &c., 365, 401, 691, 4936, 6264–6266, 7292–7431.
Evening science instruction for Owens College proposed by, 7292, 7431.

Hyde Institute.
Apparatus, &c. at, 3282, 3322–3326, 4153–4158, 4165.

Hydrographic Office.
Embraces surveys of the whole world, 11,638–11,647.

Hydrostatics.
Knowledge of, essential for a chemist, 4132.

Hygiene.
At St. Andrew's University, 9632, 9636, 9788.

I.

Ichthyology.
Lectures on, might be given at British Museum, 6593, 6613, 6641.

Income and Expenditure.
At Oxford University, 3280–3449, 3608–3611, 3787–3801, 3890–4193, 4837–4863, 13,669, 13,730–13,735.
At Cambridge University, 4243–4415, 4554–5627.
At British Museum, 6600, 6829, 7515, 7518, 9058–9105.
At Kew, 6664.
At College of Surgeons, 6869–6874.
Salary of Indian appointments, 6901–6912.
At Cooper's Hill College, 6949–6955, 13,159.
At King's College, 6962–7068, 7091–7108, 7639–7696.

Income and Expenditure—*cont.*
At University College, 7132–7169, 7799–7846.
At Newcastle College of Science, 8757–8772, 9150–9251.
For science and art in London, Edinburgh, and Dublin, 9055–9062.
At South Kensington Museum, 9067, 9072.
At Edinburgh University, 9265–9465.
At Glasgow University, 9513–9611, 9830–9905.
At St. Andrew's University, 9634–9790.
At Anderson's University, 9943–9969.
At Royal Geographical Society, 12,606–12,608.
Salary for member of State Scientific Council, 12,553, 12,582, 13,045, 13,061.
At Dublin University, 12,776–12,791, 12,909–12,913.
At Dublin University Zoological Museum, 12,937.
At Queen's College, Galway, 13,145.
At Queen's College, Belfast, 13,280–13,359.
At Catholic University of Ireland, 13,369–13,378, 13,443–13,452.
Salary for scientific investigators, 13,567–13,574, 13,730–13,735.
At Oxford Botanic Garden, 13,755–13,783.
At Museum of Practical Geology, 13,818–13,831.
Of museums, libraries, &c., in Dublin and Edinburgh, 13,859.
At Meteorological Office, 13,871–14,493.
Of Scottish Meteorological Society, 13,929–13,932.
Of meteorological observatories, 14,198–14,209.
Of Meteorological Committee, 14,217–14,230, 14,336.
Salary of Mr. Glaisher, 14,509.

India.
Royal School of Mines' students employed in, 436, 496, 520, 656, 757.
Dr. Percy's certificates for appointments in mints of, 496, 520.
Character of artizans sent to, 1830.
Importance of meteorology and astronomy in, 11,478, 11,527, 11,534, 11,893, 14,228, 14,298–14,301.
Science difficulties of Government of, 11,890–11,893, 11,916.
Want of a system of weights and measures in, 11,891.
Variety of scientific questions arising in, 12,565.
Physical astronomy observatories for, 13,071.
Students of Queen's College, Cork, employed in, 13,247.
Engineering appointments in, 1662–1664, 1765–1768.
Objection to Government engineering college for, 1765–1768.
Civil Service examinations for, 5230–5238, 7064–7066.
Supply of scientific officers for, 7105–7108.

India Office.
Council of, and proposed scientific council, 11,977, 12,984, 13,522, 13,539, 13,565, 13,594.
Scientific questions referred to Council of, 12,558–12,587, 12,726, 13,643.

Indian Civil Engineering College (Cooper's Hill).
Objections to, 5207–7138, 12,864–12,879, 13,158–13,164.

Indian Civil Service.
Want of preparation in botany and zoology shown by candidates for, 7873–7877.

Indian Telegraph Department.
Education of officers of, 5831, 6888, 7134, 7139, 7168, 7793, 7842.
Training for, at College of Chemistry, 5831.
Students appointed to, 6888, 6892.
Want of satisfactory candidates for, 6901–6912.
Officers of, instructed at University College, 7134, 7139, 7168, 7794.

Industries.
Iron-mining industry, 703.
Department science classes produce no effect upon, 6303.

Infant Schools.
Necessity of distinct schools, 5955, 8330–8332.

Inland Revenue Department.
Officers of, in College of Chemistry, 516–519, 5777, 5831.
Chemical analyses for, 5770.
Officers of, at University College, 7142, 7170.

Inspection of Schools and Science Classes.
Form used by Inspector under the Science and Art Department, App. X., Vol. I., pages *38*, *39*.
In America, 1428–1431.
Of Science and Art Department classes, 5897–5936, 5973–5976, 6173–6182, 8360–8392.
Science and Art Department might assist Education Department in, 8385.
Advantage of concentration in, 8387–8392.
Scientific inspection for training colleges, 8478.

INSPECTORS OF SCHOOLS.
- Might report upon science in elementary schools, &c., 339, 6468, 8360–8412, 8756.
- With scientific knowledge, 341.

INSPECTORS OF MUSEUMS.
- Travelling inspector, in connexion with British Museum, desirable, 3103, 3106.
- Under a council of scientific advice, 3145.

INSTITUTIONS, LITERARY AND SCIENTIFIC.
- Science schools in, 12, 5955.
- See *Mechanics' Institutes.*

INTERNATIONAL METRIC COMMISSION.
- At Paris, 11,736–11,745.

IPSWICH MUSEUM.
- Excellent arrangement of, 3103.

IRELAND.
- Science classes in, 2183.
- Government grant should be better known in, 12,442.
- Farming instruction in, 12,530.
- Large grants for science, &c., given to, 12,547.
- Representation of, in a State scientific council, 12,816.
- Want of secondary school instruction in, 13,201.
- Impediments to higher education in, 13,440–13,462.
- Effects of scientific examinations in, 13,463–13,471.
- Large numbers in, never go to universities, 13,480.
- Educational disadvantages of Irish Catholics in, 13,440–13,479, 13,492.

IRISH UNIVERSITIES.
- Correspondence between Her Majesty's Commissioners and the Heads of the, App. V., Vol. II., pages *16–19*.

IRON-MINING INDUSTRY.
- Assistance to, by Geological Survey, 703, 1980–1985.

ISELIN, J. F., ESQ., M.A.
- Evidence of, 5897–5952. Analysis of Evidence, Vol. I. App. page *105*.

ISLE OF MAN.
- Managers of mines in, 2335.

ITALY.
- Meteorology in, 10,339.

J.

JAMAICA.
- Director of Geological Survey of, 757.

JARDIN DES PLANTES, PARIS.
- Teaching and discoveries in, 6787, 6838.

JARMAIN, MR. G.
- Evidence of, 8842–9000. Analysis of Evidence, Vol. I. App. page *126*.

JELLETT, REV. J. H., B.D.
- Evidence of, 12,729*a*–12,820. Analysis of Evidence, Vol. II. App. page *181*.

JENKIN, PROFESSOR FLEEMING.
- Evidence of, 1575–1787. Analysis of Evidence, Vol. I. App. page *88*.
- On technical education and trades' unions, 1955.
- On statistics of drawing, 6081.
- On higher scientific instruction, 6089.

JERMYN STREET INSTITUTION.
- Its history, building, teaching, &c., 410–466, 2314–2492, 5984–5998, 7448, 9055–9142.
- Resorted to for advice on mining, &c., 2318.
- High scientific instruction in, 2322.
- Valuable technical library in, 7448.
- As affected by a Metropolitan College of Science, 5984.
- Want of accommodation in (see *Accommodation for Science Purposes*).
- Supported by parliamentary vote, 9055, 9063, 9072.
- Museum, &c., at, 9056–9107.
  - See *Geological Survey. Mining Record Office. Museum of Practical Geology. Royal School of Mines. Royal College of Chemistry.*

JONES, J. WINTER, ESQ., F.S.A.
- Evidence of, 6488–6586. Analysis of Evidence, Vol. II. App. page *133*.

JOINERS.
- Geometry for, 6085.

JOULE, DR., J.P., F.R.S.
- Evidence of, 10,567– ,673. Analysis of Evidence, Vol. II. App. page *192*.
- On professors and original research, 2674.

JOWETT, REV. B., M.A.
- Evidence of, 3889–3979. Analysis of Evidence, Vol. II. App. page *96*.

K.

KANE, SIR R., LL.D.
- Evidence of, 13,200–13,232. Analysis of Evidence, Vol. II. App. page *183*.

KEIGHLEY.
- Science teaching at, 5945, 6127, 6147, 6268–6276, 6388.

KEW GARDENS.
- Collections, herbarium, museums, library, officers, &c. at, 3109–3112, 6657–6845, 7203–7245, 7715–7759, 9063–9099, 10,323, 11,354–11,577, 12,190–12,194, 12,987, 13,005, 13,028, 13,907–14,487.
- Herbarium at, 6658–6702, 7718–7852.
- Competition of, with British Museum, 6660–6688, 6730–6747.
- Might supply duplicates, 6674–6677, 6728, 7217, 7232.
- Director of, responsible to Government, 6776–6778.
- Union of Kew and British Museum botanical collections, 7216.
- Connection between director of Kew and keeper of British Museum botanical collections, 7220.
- Library at Kew inferior to that of British Museum, for botany, 7746–7748.
- Objection to removal of British Museum botanical collection to, 7755–7759.
- Kew Gardens, South Kensington Museum, and British Museum overlap, 11,537, 12,987, 13,005–13,025.
- Botanical Collections at, and at the British Museum: communication from Mr. Carruthers, App. I., Vol. III., pages *1*, *2*.
- Botanical collections at, and at the British Museum: paper on the, by Mr. Carruthers, App. XV., Vol. I., pages *44–47*.

KEW OBSERVATORY.
- Maintenance of, 3109.
- Meteorological observations, &c., at, 3109–3112, 10,323, 11,354–11,475, 12,186–12,194, 13,907–14,487.

KIDD, DR.
- Good work done by, at Oxford, 4112.

KING'S COLLEGE (CAMBRIDGE).
- Combination of, with Caius and Trinity Hall, for lectures, 5198.

KING'S COLLEGE (LONDON).
- Scientific instruction, &c. at, 513–515, 687, 967, 4509, 4680, 5683, 6878–7113, 7583–7712.
- Boarding hall for, 515.
- Applied science department at, 967, 6879–6996, 7036, 7092–7123, 7583–7695.
- Workshops at, 4680.
- Professors of, 5683, 6882–6993, 7041–7119, 7657–7712.
- Lectures at, 6878–7056, 7583–7659.
- Students of, 6879–7127, 7583–7700.
- Examinations at, 6880–6928, 7036, 7085–7127, 7599–7625.
- Laboratories at, 6883–6967.
- Practical instruction at, 6883–6992.
- Evening classes at, 6883, 7031, 7583–7691.
- Demonstrators at, 6883, 6958–6961.
- Engineering instruction at, 6885–6996.
- As affected by Cooper's Hill College, 6894, 6897–6915, 7043–7063, 7109–7111.
- Funds at, 6962–6967, 7006–7068, 7091–7108, 7639–7696.
- Religion at, 6986–7001, 7012–7127, 7636, 7705–7712.
- Principal of, 6997–7001, 7072–7088, 7712.
- Government of, 7008–7012.
- Literature department at, 7015–7018.
- Museums, dissecting rooms, &c. at, 7023–7039.
- Medical department at, 7024–7040, 7092, 7097–7099, 7691.
- Associateship of, 7056, 7085.
- Claims of, to support, 7058.
- Scholarships, &c. at, 7091, 7122.
- Theological department at, 7092, 7096–7099, 7127.
- Classical department at, 7092, 7096–7099.
- Modern department at, 7092–7113, 7583–7712.
- Constitution of, 7109–7111.

KING'S COLLEGE SCHOOL.
- Its government, teaching, &c., 6918–7125.

KING'S SOMBORNE SCHOOL.
For labourers' children, 7931–7933, 8303–8312.

KNELLER HALL TRAINING COLLEGE.
Failure of, 8350.

L.

LABELS IN MUSEUMS.
At British Museum, &c., 6560, 6667, 6845.

LABORATORIES.
At School of Mines and College of Chemistry, 46, 296, 767–791, 946–948, 1211–1244, 2472–2492, 5680–5693, 5896, 8862–8945.
Under Science and Art Department, 766–774, 2154, 2260, 2177, 6105–6107, 6478–6480.
At School of Naval Architecture, 944–997, 1048, 1151.
In United States' science schools, 1468–1520.
In Glasgow University, 2698–2768, 9511, 9796–9933, 12,208.
Physical, chemical, metallurgical, and biological laboratories wanted, 2716–2725, 10,350, 10,632–11,107, 11,749–13,118, 13,575, 13,590.
Essential for all scientific teaching, 2828–2832.
At Oxford Museum, &c., 2910, 3895, 4157–4165, 4820, 4836.
At Cambridge University, 4240–5596.
Laboratory at Cambridge instituted by the Chancellor, 5070.
In Germany, 5873–5875, 7384–7407, 10,114, 10,822–10,845, 13,054–13,101.
In France, 5873–5875.
For proposed Metropolitan College of Science, 5995.
In Yorkshire, 6136–6140.
At King's College, 6883–7038.
At University College, 7132–7193, 7780–7853.
Birkbeck Chemical Laboratory, 7132–7134, 7183–7192.
At Owens College, 7267, 7364–7376, 7393–7442.
Laboratory work required for London University, 7887.
At St. Mark's College, 7904–7940.
None in Borough Road Training Colleges, 8204.
Erection of, under Endowed School Commission, 8254.
At Newcastle Medical School, 8823.
At Newcastle College of Science, 9193.
At Edinburgh University, 9264–9444, 10,203–10,205.
At St. Andrew's University, 9718, 9740–9742, 9765.
At Anderson's University, 9950–9956.
Fine private laboratory of Lord Lindsay, 10,420.
State physiological laboratory might be connected with Hunterian Museum, 11,537–11,567.
At British Museum, 11,563.
For new natural history museum at South Kensington, 11,565.
At Brown Institution, 12,323.
At Dublin University, 12,763–12,791, 12,831–12,836.
At Queen's College, Galway, 13,153, 13,154.
At Queen's College, Cork, 13,217–13,219.
At Queen's University, Ireland, 13,220.
At Queen's College, Belfast, 13,270–13,282.
At Catholic University of Ireland, 13,375–13,437.
Colleges for science would provide, if aided by State 13,524–13,526.

LADIES.
At Edinburgh University, 2726, 2730.
At Oxford University, 3178.
At University College, 7133.
At Anderson's University, 9966–9968.

LAKE, VERY REV. W. C., D.D., DEAN OF DURHAM.
Evidence of, 8757–8841. Analysis of Evidence, Vol. II. App. page *146*.

LANCASHIRE.
Need of scientific instruction in, 2136–2287, 7300, 7393–7407.
Secondary schools in, 2163–2165, 2238–2245.
Science and Art Department classes in, 7339.
Want of appreciation of science in, 9602.

LANGDALE, LORD.
On parliamentary responsibility in connexion with British Museum, 9089.

LANGUAGES.
As an element of training, 4846, 4864–4876, 5569–5584.
Classics at University School, 7145.
In Scottish training schools, 9579.
In new scheme for science degrees at Glasgow, 9868.
In secondary schools, 12,261–12,263.

LATHAM, REV. H., M.A.
Evidence of, 5192–5279. Analysis of Evidence, Vol. II. App. page *124*.

LATIN.
For science students, &c., 3274, 3414, 3721, 3922, 3948–3974, 4018, 4027, 4189, 4864–4868, 7092–7094.

LAW.
At Oxford University, 3897, 4189
At Glasgow University, 9867.
Advice on science obtained as on law, 13,561, 13,582–13,584.

LAWES, MR. See *Agriculture*.

LAWSON, PROFESSOR.
Evidence of, 13,753–13,815. Analysis of Evidence, Vol. II. App. page *107*.

LECTURE ROOMS.
Should have sloping floors, 6268.

LECTURES.
At Royal School of Mines and College of Chemistry, 363–375, 442, 531–563, 718–735, 2472, 2486, 5730, 5777, 5831, 7472.
At University College, 718.
At School of Naval Architecture, 943–1152.
French "répétiteurs" for, 1144–1148.
For telegraphy, 1591–1593.
Under Science and Art Department, 2034–2036.
To working men, 2472, 2486, 6144, 7472, 9811, 9966.
At Glasgow University, 2751–2754, 9506–9601, 9908.
At Oxford University, 2916–4190, 13,661.
At Cambridge University, 4231–5530.
At Leeds, 6144.
At British Museum, 6503–6506, 6593–6759, 7460–7478, 10,115–10,127, 11,537.
At Hunterian Museum (Royal College of Surgeons), 6590, 6784–6786.
At Royal Institution, 6593.
At Kew Gardens, 6665, 6697–6700.
At new South Kensington natural history museum, 6784–6797, 6856–6859.
At Jardin des Plantes, 6785–6787.
At King's College, 6878–7656.
By Mr. Ellis, 8742, 8755.
At Durham University, 8763–8782.
At Newcastle College of Science, 8766–8772.
At Edinburgh University, 9264–9470, 11,023–11,025.
At St. Andrew's University, 9706–9757.
At Anderson's University, 9948–9972.
In German universities, 10,111–10,114.
At Muséum d'Histoire Naturelle, Paris, 10,136–10,139, 10,187.
By officers of State scientific institutions, 10,425, 10,441.
Men carrying on research should not give, 10,804–10,809.
On metric system in France, 11,656.
Every scientific professor should give, 12,237–12,243.
At Dublin University, 12,730–12,904.
At Queen's College, Cork, 13,201.
At Queen's College, Belfast, 13,336.
State-appointed investigators should publish results in, 13,567, 13,591–13,593.

LEE'S READERSHIPS.
At Oxford, 2906, 2934, 3289, 3388, 3546, 3654–3657.

LEEDS.
Science college at, desirable, 2924, 5109, 8785–8788, 9259.
Schoolmasters' science classes at, 5905, 8862.
Science lectures to working men at, 6144.
Museum at, 6216.
Technical classes at, 8891–8895.

LEIPZIG.
Large laboratory at, 47, 10,831–10,835.
Scientific instruction in, 7384–7391.

LEITH.
Navigation school at, 845, 870.

LESLIE, REV. J. R., M.A.
Evidence of, 12,821–12,888. Analysis of Evidence, Vol. II. App. page *181*.

LETTER.
From the Hon. Mr. Justice Grove, F.R.S., touching the advancement of science, App. XVI., Vol. II., page *71*.

LEUSCHNER, M.
His opinion of English miners, 2402.

LIBRARIES.
At Cambridge University, 3586.
At Oxford University, 3586, 3589.

- Libraries—*cont.*
  - At British Museum, 6492, 6541, 6783, 7746–7759, 10,128, 10,190–10,194.
  - At Kew, 6668.
  - For new South Kensington natural history museum, 6783.
  - At Museum of Practical Geology, 7448, 13,818.
  - At Edinburgh University, 9270–9281.
  - At St. Andrew's University, 9655–9669, 9768.
  - At Anderson's University, 9980–9983.
  - For natural science, could not be formed under 25 years, 10,190.
  - Government should establish, 10,596–10,602, 11,119.
  - Wanted round Manchester, 10,602.
  - At Queen's College, Cork, 13,226–13,229.
  - At Queen's College, Belfast, 13,280–13,292, 13,333.
  - At Catholic University of Ireland, 13,375.
  - At Oxford Botanic Garden, 13,759, 13,798.
  - At South Kensington Museum, 13,833.
- Liddell, Very Rev. H. G., D.D.
  - Evidence of, 4144–4226. Analysis of Evidence, Vol. II. App. page *103*.
- Light.
  - Instruction in, 4324, 7824, 9450.
- Lightfoot, Rev. J. P., D.D.
  - Evidence of, 3980–4089. Analysis of Evidence, Vol. II. App. page *98*.
- Lighthouses.
  - Experiments for, 12,622–12,631.
- Linacre Professorship (Oxford).
  - Foundation, lectures, &c., 3211–3227.
- Lincoln College (Oxford).
  - Income of, 3867.
- Lindley, Dr.
  - On removing British Museum botanical collections, 7739–7740.
- Lindsay, Lord.
  - Superior private laboratory of, 10,420.
- Literature.
  - As affecting scientific training, 1734–1736, 2665–5404, 7015–7897, 9292–9928, 12,740–12,893.
  - At Oxford, University, 2906, 3275–3427, 3754–4221, 4822–4852.
  - At Rugby School, 3697.
  - Literary education alone is undesirable, 3734.
  - In German realgymnasia, 3742–3745.
  - Classics and mathematics, for school-boys, &c., 4265, 4303.
  - At Cambridge University, 4306, 4641, 5003–5178, 5382, 5404.
  - Classical knowledge necessary for men of science, 4758.
  - Contest in Germany between classics and science, 5217.
  - At King's College, 7015–7018.
  - At Edinburgh University, 9292.
  - At Glasgow University, 9527–9529, 9917–9928.
  - At Dublin University, 12,740–12,753, 12,855, 12,893.
- Lithology.
  - In Glasgow University, 9506.
- Liveing, G. D., Esq., M.A.
  - Evidence of, 4527–4653. Analysis of Evidence, Vol. II. App. page *114*.
- Liverpool Free Museum.
  - Success of, 3103, 10,225, 10,295–10,297.
- Local Boards.
  - For science classes, &c., 2, 14, 6436–6442, 9052.
- Local Secretaries.
  - Payment of, 7.
- Lockyer, J. Norman, Esq., F.R.S.
  - Popular science lecture by, 7431.
  - His spectroscopic sun observations, 11,354, 11,524.
- Lodgings for Students.
  - None connected with German colleges, 5274.
  - At St. Mark's College, 7996–8007.
  - Apart from a training college, 7998–8007, 8046–8052, 8232–8250, 8521.
  - Not contemplated at Newcastle, 8020.
  - In connection with Newcastle Medical School, 8821.
  - Hall at St. Andrew's University, 9646.
- Logan, Sir William.
  - Directed Geological Survey of Canada, 757.
- Logic.
  - At Oxford University, 3767–3769, 4007.
- London.
  - Science teachers brought to, for instruction, 275–277, 289, 612, 628, 2174–2177, 7433, 8027, 8065.
  - Dislike of manufacturers to send their sons to, 513–515.
  - Advantage of, for high scientific instruction, 2322.
  - Keeping British Museum botanical collections in, 7737–7745.
  - London and Newcastle for science training, 8805–8811.
  - Vote for science and art in, 9062.
  - Not the best place for teaching applied science, 9157.
  - Too distant from manufacturing centres for a science college, 9218–9221.
  - State laboratories should be founded near, 10,367, 10,696, 10,711, 11,071, 13,056, 13,107, 13,109.
- London University.
  - System of examiners at, 1318.
  - Degrees at, 3755–3857, 7257–7343, 7364, 7783–7893.
  - Students at, 6892, 6896, 7782–7893.
  - Examinations of, 7783, 7785, 7865–7887.
  - Might take up higher scientific teaching, 10,926, 10,952.
  - Open to students of Catholic University of Ireland, 13,479.
- Lord President.
  - Responsible for South Kensington Museum, School of Mines, &c., 9063–9066, 9083, 9091.
  - British Museum might be under, 9106–9112, 13,581.
- Lyceum.
  - At Oldham, 1795–1802, 1912–1914.
- Lyell, Sir Charles, Bart.
  - On retaining British Museum botanical collection in London, 7739–7740.
- Lyons, R. D., Esq., M.B.
  - Evidence of, 13,361–13,423. Analysis of Evidence, Vol. II. App. page *186*.
- Lyttelton, Lord.
  - On separating classical from scientific schools, 3694, 3701.
  - Letters from (as Chairman of the Endowed Schools' Commission), to the Vice-Chancellors of the Universities of Oxford and Cambridge, App. VIII., Vol. I., pages *32, 33*.

M.

- Macalister, A., Esq., M.B.
  - Evidence of, 12,889–12,960. Analysis of Evidence, Vol. II. page *182*.
- Machinery and Machine Drawing.
  - Teaching of, 1629, 1802–1828, 1852, 1892–1894, 5953, 7451, 9523–9537.
  - At Oldham science school, 1802.
  - Advantage of knowledge of, to artizans, 1809, 1852, 1892–1894.
  - Improving character of foreign machinery, 1845–1848.
  - Estimate for, in proposed science college, 5953.
  - Models in teaching machinery, 7451.
  - In Glasgow University engineering course, 9523–9537.
  - See *Construction, Machinery, and Building, Drawing.*
- Mackworth, Mr.
  - Originator of Bristol Mining School, 6334, 6400.
- Magdalen College (Oxford).
  - Promotion of science in, 2997–3608, 4114.
  - Waynflete professorships at, 3381–3384, 3411.
  - Chair of mineralogy to be founded by, 4114.
- Magellan Straits' Expedition. See *Survey Expeditions.*
- Magenta.
  - Invented and manufactured by students of College of Chemistry, 5683.
- Magnetic Department.
  - Management of, 11,200–11,211.
- Magnetic Observations.
  - At Kew, 3111.
- Magnetism.
  - At University College, 7822.
- Magnus, Professor.
  - On technical instruction, 7283.
- Main, Rev. R., M.A.
  - Evidence of, 14,115–14,210. Analysis of Evidence, Vol. III. page *10*.

MALACOLOGY.
  Lectures on, might be given at British Museum, 6593, 6613, 6641.

MANAGERS OF MINES.
  Importance of education of, 1701–1707, 1784, 9811.
  Ignorance of, as regards science, 9601–9610.
    See *Miners.*

MANCHESTER.
  Advantage of position of, for scientific instruction, 1778, 7340, 8957.
  Science school in, started by artizans, 1956.
  Importance of having a science college in, 2925.
  Practical science school desirable at, 5109.
  Schoolmasters' science classes at, 5905.
  Necessity for science being taught in, 7253.
  Owens College extension in, 7266, 7301–7307.
  Desire in, for increased scientific instruction, 7300.
  Large amount of science teaching in district of, 7338, 7431.
  Royal School of Medicine in, 7376–7379.
  Important industries in, depending on science, 7407.
  Manchester Chemical Works, 7407.
  Lectures in, by Professor Huxley, Mr. Norman Lockyer, &c., 7431.
  With secondary schools, would possess elements for a graduated system of instruction, 8343.
  Grammar school at, 8345.
  Observatory near, desirable, 10,572.
  Government aid to museums of, desirable, 10,581–10,590.
  Manchester Philosophical Society, 10,596–10,673.
  Libraries wanted round, 10,602.
  Best provincial school for physiology at, 12,302–12,305.
    See *Owens College.*

MANUAL LABOUR.
  Education, as affecting, 1539.
  Early training for, &c., 1809, 1851–1896, 1985–1991.

MANUFACTURERS.
  Dislike of, to send their sons to London for instruction, 475.
  Little encouragement given by, to science teaching in East Lancashire, 2163–2239.
  Support of mechanics' institutes, &c., by, in Yorkshire, 6145–6147.
  Keighley Institute due to, 6147.
  Proposed science college for sons of, in Yorkshire, 6148.
  Desire of, for establishing technical classes, 8898.

MANUFACTURES.
  Income from, and from science teaching, 447.
  Teaching of science applied to, 747, 750, 2793–2859, 7367.
  As impediments to science, 3587, 3642–3648.
  Proposal to include, in a high science school in Bristol, 6428–6431*a*.
  As a career for chemists, 7181*a*.
  Improvements in iron manufacture, 9166–9177.
  Scientific men wanted in centres of, 9174–9177.
  Scientific instruction and apprenticeship in, 9178–9182.
  Want of scientific knowledge among persons engaged in, 9204–9206, 9255–9260.
  Foremen and apprentices in, 9227.
  Value of scientific knowledge in connexion with, 10,039–10,078.
  Students of Anderson's University distinguished in, 10,066–10,070.
  Applications of chemistry to, 10,059–10,078.

MAPS OF THE GEOLOGICAL SURVEY.
  Progress of, &c., 408, 703–705, 754–757.
  Signor Sella and M. Marcou on, 757.

MAPS OF THE ORDNANCE SURVEY.
  Progress of, 754.

MARBURG UNIVERSITY.
  Original research at, 5868.

MARCOU, M.
  On Geological Survey of Britain, 757.

MARINE ENGINEERS.
  Education of, &c., 923–934, 1090–1101.

MARRIAGE.
  As affecting Oxford fellowships, 3679, 3807, 3976, 4053.
  As affecting Cambridge fellowships, 4373, 4967, 5360, 5395–5398, 5566, 5635.
  Objection to restriction of, on college lectureships, 5043, 5049.

MASKELYNE, PROFESSOR.
  Evidence of, 4090–4143, 7453–7518. Analyses of Evidence, Vol. II. App. pages *101*, *138*.
  On South Kensington plans for British Museum, 6604.
  Paper handed in by, respecting the removal of the Mineralogical collection of the British Museum to South Kensington, App. XIV., Vol. I., pages *43*, *44*.

MASSACHUSETTS.
  Cambridge Museum in, 1531–1534.
  Education in, as affecting manual labour, 1539.
  Harvard School of Mining and Practical Geology in, 2471.
  Museum of natural history at, 6597.

MATERIA MEDICA.
  At Edinburgh University, 9264, 9284.

MATHEMATICIANS.
  Contrasted with physicists, 1666, 1667.

MATHEMATICS.
  State payment for, 115.
  Should be taught in elementary schools, 355–357, 5922.
  Want of, at School of Mines and College of Chemistry, 430–433, 540, 541*a*, 566, 1108, 1141–1143, 2422, 2524, 6425.
  At School of Naval Architecture, 890, 987, 1066, 1068, 1106, 1141–1143.
  Special school for, 1065, 1110–1113.
  Aid to, by Smithsonian Institution, 1407, 1419, 1505.
  At Oldham Science School, 1806, 1908.
  At École du Génie Maritime, Paris, 1063–1067.
  In Plymouth Schools, 2096.
  Mining course should include, 2520–2523.
  At Oxford University, 2906, 3273–3372, 3457–3569, 3756–4194, 4824.
  Earlier university examinations in, 3011–3015.
  Mr. Scott Russell's assignment for, 3471.
  Savilian professorships of, at Oxford, 3472–3477.
  Teaching of, to boys, 3735, 4303, 6369.
  At Cambridge University, 4231–4540, 4658–4824, 5084–5404, 5577, 10,496–10,505.
  Combination of college lecturers for teaching, 5193–5196.
  In Bristol Trade School, 5945, 6369.
  Estimate for, in proposed science college, 5953.
  At King's College, 6879, 7030.
  At University College School, 7144, 7146.
  At University College, 7146, 7149, 7780–7822.
  Essential to study of geology, 7625–7628.
  At Newcastle College of Science, 8766–8768, 9153.
  At Edinburgh University, 9400 9450.
  At Glasgow University, 9506–9508.
  At St. Andrew's University, 9616-9622, 9709.
  In higher schools of Scotland, 9815.
  At Anderson's University, 9949.
  Want of, by scientific apparatus makers, &c., 10,494.
  At Dublin University, 12,744–12,753, 12,855.
  At Queen's College, Galway, 13,177, 13,192.
  At Queen's College, Cork, 13,201, 13,234, 13,244.
  At Queen's College, Belfast, 13,256–13,269.

MATRICULATION.
  None at School of Mines, 394.
  At Oxford University, 3295–3461, 3536–3573, 3613–3883, 3901–4033.
  At Cambridge University, 4483–4485.
  Different meanings of, 9290.
  In Scottish universities, 9290.
  At Edinburgh University, 9413–9416.
  At Queen's College, Cork, 13,201–13,225.

MAURITIUS.
  Meteorological Society and State observatory in, 11,478.

MCCLELLAND, J., ESQ.
  Evidence of, 9934–10,019. Analysis of Evidence, Vol. II. App. page 176.

MECHANICAL DRAWING.
  At School of Mines, 365.
  Professor Fleeming Jenkin on, 6081.
  State payment for, 6082.
  Under Science and Art Department, 6082–6084.
    See *Drawing.*

MECHANICS.
  State payment for, 115.
  Teaching of, to boys, 319, 3057.
  At Oxford University, 3329, 3569.
  At Cambridge University, 4394, 4399.
  Study of, in universities and in industrial centres, 5109.
  Teaching of, in public schools, 5225–5229.
  At Bristol Trade School, 5945.

MECHANICS—*cont.*
At King's College, 6883, 7021, 7030.
At Glasgow University, 9506.
At Anderson's University, 10,065.
Illustrations of, at South Kensington, 13,845–13,857.
See *Applied Mechanics.*

MECHANICS' INSTITUTES.
Use of, for science schools, 12, 37, 1640.
In East Lancashire, 2136–2162.
At Burnley, 2162.
At Haslingden, 2162.
At Bacup, 2162.
Under Yorkshire Union, 6113–6147.
In Bradford, 6295.
Birkbeck Chemical Laboratory partly built by subscriptions from, 7134.
For teaching science to artizans, 8866.
Early science teaching in, 8868, 9017–9027.
Committees of, anxious to extend science, 8883–8888.
Union of, formed by Society of Arts, 9002, 9045–9047.
At Glasgow, 9593.
Originated through Anderson's University, 9968.

MECHANISM.
At Cambridge University, 4654–4672, 4678–4689.
Professor Farish's lectures on, 4657, 4668, 4690.
Estimate for, in proposed science college, 5953.
Exhibition of models, &c. for study of, 13,062.

MEDICAL SCHOOLS.
Teaching, cost, &c. of, 973–976, 1293–1296, 1755, 4895.
See *Royal School of Medicine, Manchester.*

MEDICAL STUDENTS. See *Students.*

MEDICINE.
Technical part of, must be learned in hospitals, 2807.
Universities should train for entering schools of, 2920–2922.
At Oxford University, 2942, 3235, 3897–3967.
Greek should not be compulsory for students of, 2973, 2976.
Scientific education for, is inadequate, 3580.
Definite scientific career at universities desirable for students of, 3581.
Caius College fellowships for physicians, 4371, 4512.
At Cambridge University, 4371–4998.
At high science school at Bristol, 6428–6431*a*.
At College of Surgeons, 6853–6868.
At King's College, 6883–7099.
Except in the medical department, there is no regular biological instruction at King's College, 7691.
In London University examinations, 7783, 7878.
At Edinburgh University, 9264–9496.
At Glasgow University, 9571–9841.
At St. Andrew's University, 9787.
Veterinary institutions, 9800.
New Western Infirmary at Glasgow and University Medical School, 9930.
At Anderson's University, 9942–9962.
In German chemical laboratories, 11,103.
Connexion between, and physiological research, 12,294–12,343.
University honours in, a mistake, 12,300.
Grants for schools of, 12,302–12,305.
Central scientific school for, 12,338–12,342.
At Dublin University, 12,831–12,926.
At Queen's College, Galway, 13,177–13,188.
At Queen's College, Cork, 13,202.
At Queen's Colleges, Ireland, 13,215–13,220.
At Queen's College, Belfast, 13,263, 13,324.
At Catholic University of Ireland, 13,380, 13,420.
At Queen's University, 13,472–13,479.
Catholic students of, 13,472–13,479.

MEDLOCK, MR.
Inventor of magenta, 5683.

MEETING OF SCIENCE TEACHERS.
Respecting Department examiners, 635.

MEMORIAL.
Addressed to the Department of Science and Art by the Director of the Royal School of Mines, touching the First Report of the Royal Commission on Scientific Instruction and the Advancement of Science, App. III., Vol. II., pages *2–4.*
Of the British Association for the Advancement of Science to the Lords Commissioners of Her Majesty's Treasury, respecting Tidal Observations, App. IX., Vol. II., page *32.*
Of the Council of the Royal Society of Edinburgh, App. XIV., Vol. II., pages *67–70.*

MENSURATION.
Should be taught in elementary schools, 7985.

MERCHANT SERVICE.
Connection of Meteorological Office with, 13,896–13,903.

MERRIFIELD, C. W., ESQ., F.R.S.
Evidence of, 1021–1168. Analysis of Evidence, Vol. I. App. page *84.*

MERTHYR.
As a centre for a mining school, 2567–2625.

MERTON COLLEGE (OXFORD).
Science teaching in, 2997–3283, 3608, 3654, 4003, 6892.

METALLURGY.
At Royal School of Mines, 363–508, 742–752, 2472–2492.
Teaching of, to artizans, 1878.
Early knowledge of, 1880.
Technical, in science schools, 2796–2806.
Importance of knowledge of, 9155–9158, 11,354.
Foreign distinguished metallurgists, 9157.
Important English inventions in, &c., 9166–9177.
Apprenticeship to, 9178–9182.
Lectures on, wanted at Edinburgh University, 9373.
National laboratory for, 10,411–10,441, 10,963–10,975, 11,072, 11,930–11,943.
New standard trial plates for coins, 11,656, 11,751, 11,753.
M. St. Claire Deville's experiments on, 11,749–11,751.
Necessity for investigations in, 11,930–11,943.

METEOROLOGICAL COMMITTEE.
Work of, 11,354–11,377, 12,407–12,414, 14,035–14,375.

METEOROLOGICAL OBSERVATIONS.
At Kew, assisted by Board of Trade, 3112.

METEOROLOGICAL OFFICE (LONDON).
Its organization, staff, want of funds, &c., 9908, 10,329–10,349, 11,212–11,263, 11,403–11,526, 11,789, 12,639–12,666, 13,861–14,529.
Direction of, 11,403–11,526.
Connexion of, with Royal Society and Board of Trade, 12,639–12,642, 12,661–12,666.
Mr. Glaisher's work for, 14,497–14,553.
Registrar-General's returns furnished by, 14,515–14,521, 14,533–14,538.
Should confine itself to sea operations, 14,518–14,529.
Supplementary Evidence respecting the, in a communication from the Director, App. III., Vol. III., pages *5, 6.*

METEOROLOGICAL OFFICES (FOREIGN).
Relation of, to London office, &c., 13,956–14,092.

METEOROLOGICAL RETURNS FURNISHED TO THE REGISTRAR-GENERAL BY MR. GLAISHER.
Correspondence with the Treasury relating to the, App. II., Vol. III., pages *2–5.*

METEOROLOGICAL SOCIETY (LONDON).
Its publications, &c., 13,925–14,268.
Might be employed for climatic meteorology, 14,053.

METEOROLOGICAL SOCIETY (SCOTLAND). See *Scottish Meteorological Society.*

METEOROLOGIST ROYAL.
Suggested appointment of, 14,035–14,109.

METEOROLOGY.
Under Smithsonian Institution, 1407, 1409, 1425.
In science schools, 2064, 2111.
At Radcliffe Observatory, 3652.
Physical laboratory for, 7418.
Local meteorology, 10,338.
On the continent, 10,339.
At Greenwich and Kew, 10,490, 11,450–11,475.
Scientific organisation as regards, 11,354.
Observations on, wanted from Greenland, &c., 11,354–11,534, 14,062–14,066, 14,117–14,171.
In India, America, France, &c., 11,364–11,534, 12,460, 12,513, 14,227.
Importance of, to India, 11,893.
In Scotland, 12,357–12,414, 14,302–14,380.
In Scottish schools, 12,411, 12,460.
Observatory for, 13,861–14,020, 14,381–14,496.
Centralization for, 13,951.
Metric system for, 13,963.
Advances in science of, 14,021–14,023, 14,293.
Physical and climatic, 14,031–14,047, 14,057, 14,067–14,101, 14,153, 14,269–14,284, 14,323–14,341.

Meteorology—*cont.*
- State aid for, 14,031–14,047, 14,057, 14,067–14,101, 14,211–14,297.
- Special expeditions for, 14,048.
- Stations for, 14,062–14,066.
- At Oxford, &c., 14,115–14,210.
- At astronomical observatories, 14,120.
- International, 14,129–14,138, 14,169, 14,319.
- Photographic observations in, 14,160–14,169.
- In tropical countries, 14,228.
- Scientific part of, 14,295.
- Maritime, 14,341–14,350, 14,518.
- Inspection for, 14,351–14,364.
- Want of Government department for, 14,365–14,371.
- Mr. Glaisher's observations on, 14,497–14,553.

Method.
- Department of, 6211–6234.
  - See *Professor of Method.*

Metric System.
- Teaching of, in schools, &c., 11,656.
- International Metric Commission at Paris, 11,736–11,745.
- For meteorological observations, 13,963.
  - See *Weights and Measures.*

Metropolitan College of Science (proposed).
- Proposal to create a central science school, 2.
- For teachers; its organization, staff, salaries, &c., 42–72, 184–351, 2473, 5756–6074, 6202–6232, 6793, 8015–8029, 8045–8054, 10,946.
- South Kensington as a locality for, 49, 54.
- As affecting School of Mines and School of Naval Architecture, 202, 2473, 5984, 6035.
- For teaching pure science, 331, 334.
- Governing body of, 5850–5852.

Metropolitan Railway.
- As affecting South Kensington science schools, 5752.

Miall, L. C., Esq.
- Evidence of, 6236–6323. Analysis of Evidence, Vol. I. App. page *110.*

Microscope.
- Requisite for all science teachers, 4940.

Microscopy.
- At Edinburgh University, 9264.

Middle-class Schools.
- Science teachers in, 5956.
- Graduated inspection for, 5974–5976.
  - See *Schools.*

Midwifery.
- Instruction in, at Edinburgh University, 9264.

Military Colleges.
- Objection to special, 2819.

Mill Managers' Club.
- At Augsburg, 1848.

Miller, Dr. (of Cumberland).
- On British rainfall, 3113.

Miller, Professor.
- His system of crystallography, 4103, 4113.

Milne-Home, D., Esq., LL.D.
- Evidence of, 12,415–12,547. Analysis of Evidence, Vol. II. App. page *204.*

Mineralogical Collection of the British Museum.
- Paper handed in by Professor Maskelyne as to the removal of the, to South Kensington, App. XIV., Vol. I., pages *43*, *44.*

Mineralogy.
- As affecting teachers in a science college, 292.
- At School of Mines, 365, 2314, 2333, 2433, 2461, 5984.
- Under Science and Art Department, 2290–2396.
- For schools, 2294–2297.
- Geometry, chemistry, &c. essential for, 2460.
- At Oxford University, 3172, 3202, 3383, 4091–4143.
- For a school of examination, 4119–4121.
- At Cambridge University, 4453, 4707, 5108.
- At British Museum, 6493, 6571, 6593, 6613, 6641, 7444–7447, 7477–7481.
- At King's College, 7021, 7023, 7030.
- Requirements for teaching, at South Kensington, 7441–7447.
- At Newcastle College of Science, 8766, 9153.
- Professorship of, 8790.
- At Dublin University, 12,828–12,830.

Miners.
- Accidents among, 1969.
- Education of, 1994–2647.
- From Royal School of Mines, 2369, 2498, 2525–2530.
- English and continental, 2400.
- Education of managers of, 2402, 2403.
- M. Leuschner on, 2402.
- Cornish school for, 2406.
- Advantage of secondary schools to, 2407.
- Boys training for, 2416–2418.
- Should be instructed where the mines are, 2437, 2510–2512.
- From mining schools of Bristol and Glasgow, 2498, 2502, 2510–2512, 2559–2561.
- Education of viewers, 2506, 2517–2616.
- Training young working miners for overmen, 2517–2519.
- Viewers of Northumberland and Durham, 2544.
- Recklessness of, 2556.
- School for, at Merthyr, 2567–2570.
- Belgian mining engineers, 2599, 2630.
- Loss through bad education of, 2600–2602.
- Surveying conducted by, 2606–2609.
- Taxing wages of, for education, 2620–2622, 2648–2650.

Mines.
- Ventilation of, 707, 2636–2645.
- Education of those engaged in, 1994–2647, 9204.
- In Prussia, 2326–2328.
- Assessments on, for science schools, 2449–2465, 2619–2623, 2648, 2650.
- Subscriptions of owners of, to mining schools, 2499, 2502, 2507–2510, 2626.
- Scientific knowledge essential for working, 2506, 2517–2526, 2603–2605, 2540, 2554.
- Economy in, from higher education, 2539–2546, 2592.
- Accidents in, 2547, 2632–2638.
- In Wales and Monmouthshire, 2576.
- Future deep working of, 2596–2599.
- Loss of coal in Staffordshire, 2600–2602.
- Explosions in, 2603–2605.
- In Belgium, 2632–2645.

Mines' Regulation Bill.
- Certificated managers under, 9613.

Mining.
- Instruction in, at Royal School of Mines, 43, 363–365, 543–546, 657–742, 2291–2340, 5953, 5984, 6108.
- Assistance to, by Geological Survey, 703–706, 754–756.
- Want of professorships in, 713–729, 740.
- Importance of science in connection with, 1198, 1215, 2344.
- Under Science and Art Department, 2293–2313, 2352–2354.
- Science instruction in outlying districts, 2358–2360.
- Diversity of practice in, 2397–2399.
- Technical instruction in, &c., 2816, 2850–2852.
- Principles of, only, should be studied in universities, 5191.
- At Bristol Trade School, 6342, 6409–6412.
- Proposal to include, in a high science school at Bristol, 6428–6431*a*.
- Space required at South Kensington for a professor of, 7441–7447.
- At King's College, 7595–7597.
- Schools in mining districts, 8469–8486, 8647–8651, 8697.
- In Black Country schools, 8501–8506.
- Belgian system of, 8505.
- At Newcastle College of Science, 8764–8840, 9153.
- Mining school, library, and models should be together, 9142.
- At Edinburgh University, 9470, 9493.
- At Glasgow University, 9601.
- Failure of school for, at Glasgow, 9601.
- Certificated managers for, 9603–9605, 9613.

Mining Engineers.
- Objections of, to substitute School of Mines' courses for apprenticeship, 2424.

Mining Inspectors.
- No connexion between, and School of Mines, 2457, 2459.

Mining Proprietors.
- Their knowlege of science, &c., 2499–2646.

Mining Record Office.
- Great value, re-organization, &c. of, 2341, 2472, 5724, 5985.

Mining Schools.
  In Cornwall, Bristol, Glasgow, &c., 2301, 2361, 2411–2414, 2465, 2499, 2578–2580, 2626.
  In France, Germany, &c., 2325–2463.
  For Swansea, 2364.
  Contributions for, 2362, 2383, 2447–2465.
  Assistance by South Kensington to, 2386.
  Want of, in Wales, 2510–2512, 2567–2577, 6415.
  Subjects to be taught in, 2517–2524.
  Viewers not favourable to, 2553.
  Proprietors see necessity for, 2554.
  Want of, at Merthyr, 2567–2570.
  Cost of, 2585–2593.
  Training of viewers' apprentices in, 2614–2616.
  Difficulty of supporting local schools, 2617.
  Tax upon coal or wages for, 2619–2623, 2648–2650.
  Affiliation of, to some other institution, 6428.
    See *Bristol Trade School—Science Schools.*

Mining Schools (Continental).
  Curriculum of, &c., 2325–2463.

Minister for Education and Science.
  Proposed appointment of, 1390, 3123, 6775–6778, 7222–7238, 9118–9144, 10,524, 10,747–10,984, 11,354–12,728, 13,035–13,136, 13,517, 13,577, 13,656.

Minister of Instruction.
  Museums subject to, in Germany and France, 10,099–10,184.

Mint. See *Royal Mint.*

Minute.
  On foundation of Science and Art Department, 2.
  On science teachers, 6052–6056.

Models.
  For teaching machinery, 7451.

Moderatorships.
  At Dublin University, 12,893.

Monmouthshire.
  Mining school proposed for, 2576.

Moon.
  New map of, 3116–3118.

Morgans, Mr. William,
  Mining instruction by, 6405, 6412.

Moseley, Canon.
  Connexion of, with Bristol Trade School, 6397, 6431*a*.

Munich.
  Science instruction in, 7389.

Murchison, Sir Roderick I., Bart.
  Evidence of, 2468–2493. Analysis of Evidence, Vol. I. App. page *100*.
  On want of accommodation, &c. at School of Mines, 47, 51, 74–76, 435–437, 520–522, 674, 5985.
  On want of accommodation, &c. for Geological Survey, 674, 696.
  Contribution of, to chair of geology at Edinburgh University, 9464.

Muséum d'Histoire Naturelle (Paris). See *France.*

Museum of Economic Geology. See *Museum of Practical Geology.*

Museum of Natural History (Dublin).
  Cost of, &c., 9055–9072.

Museum of Naval Architecture.
  At South Kensington, 9136–9141.

Museum of Oxford. See *Oxford University.*

Museum of Practical Geology.
  Its foundation, object, collections, want of accommodation, &c., 362–472, 670–731, 2315, 2473, 5985, 6108–6111, 6639, 7644–7646, 7764, 11,541–11,545, 13,816–13,831.
  Founded to exhibit industrial application of geology, 13,816–13,831.
  Evening exhibition of, 13,819–13,831.
    See *Geological Survey, Royal School of Mines, &c.*

Museum of Science and Art (Edinburgh).
  Its collections, lectures, &c., 1630–1632, 9284, 10,207–10,302.
    See *Edinburgh Museum.*

Museums.
  Provincial, 3103–3106, 6428, 6504, 9073–9148, 10,144–10,309, 11,119, 11,264–11,271, 12,104–12,137.
  At Bristol, 3103, 6428.
  At Ipswich, 3103.
  At Liverpool, 3103, 10,225, 10,295–10,297.
  At York, 3103.
  Government inspection for, 3106.
  Universities should found, 3583, 3649.
  At Oxford, 3709–3714, 3238.
  As affecting scientific instruction, 5953.
  At Leeds, 6216.
  None in Yorkshire mechanics' institutes, 6216–6218.
  Injury from dust in, 6540–6549.
  At Massachusetts, 6597.
  Lighting of, 6639.
  Continental, 6658, 10,135.
  At King's College, 7023, 7027, 7099.
  At University College, 7132.
  Number of students the test of usefulness of, 7463.
  In Germany, open on Sunday, 7508.
  Supported by parliamentary vote, 9055–9072.
  Management, &c. of, 9056–9148.
  Turnstiles in, 9067–9070.
  Loans from South Kensington to, 9076.
  Responsible minister for, 9088, 9118–9131.
  Employing policemen in, 9109.
  At Edinburgh University, 9264–9324.
  In Scotland, 9487.
  At St. Andrew's University, 9638–9788.
  In Glasgow University, 9888–9909.
  Educational importance of, 10,144–10,173, 10,578.
  Of machines, &c., 10,434–10,442, 10,494.
  Patented processes in, 10,668–10,670.
  Survey expedition specimens in, 10,936–10,938, 11,539, 11,595, 11,600–12,137.
  Trade collectors for, 10,960.
  Evil of competition of, 11,357.
  One metropolitan museum for all departments of natural history desirable, 11,546.
  At Dublin University, 12,825–12,940.
  Of Royal Dublin Society, 12,941–12,943, 12,959.
  At Queen's College, Galway, 13,155.
  At Queen's College, Cork, 13,201.
  At Queen's College, Belfast, 13,317, 13,329, 13,357.
  At Catholic University of Ireland, 13,369–13,384, 13,438.
  At Oxford Botanic Garden, 13,759–13,804.
  Deputation from Society of Arts respecting, Vol. II. page 365.
    See *British Museum, Museum of Practical Geology, South Kensington Museum, &c.*

Music.
  Teaching of, in schools, 8451–8458.
  At Edinburgh University, 9276–9281.
  Reid Bequest for, 9276–9281.
  At Anderson's University, 9968–9970.

N.

Nasmyth, Mr., of Patricroft.
  His mechanical drawing, 1894.

National Academy (America).
  Incorporation of, &c., 1525–1529.

National Gallery (Edinburgh).
  Government of, &c., 9055, 9063–9066.

National Gallery (Ireland).
  Government of, &c., 9055–9066.

National Gallery (London).
  Government of, &c., 9055–9083.

National Portrait Gallery (London).
  Government of, &c., 9055–9147.

National Schools.
  Scientific instruction in, &c., 853–855, 1199–1203.
    See *Elementary Schools.*

National School Teachers.
  Science taken up by, 5952.
    See *Elementary Schoolmasters.*

Natural History.
  At School of Mines, 365, 691.
  Connected chair of, and geology, 686, 2741–2743.
  Promotion of, by Smithsonian Institution, 1407–1426, 1489.
  In relation to American coast surveys, 1461–1464.
  Defective classifications of specimens of, 3103, 3106.

NATURAL HISTORY—*cont.*
Travelling inspector for, 3103, 3106.
Field-clubs for, 3205.
At Edinburgh University, 9276, 9284, 9312, 9464, 9471–9482, 10,203–10,289.
At Glasgow University, 9571–9614, 9932.
At St. Andrew's University, 9629–9631, 9788–9790.
At Glasgow Hunterian Museum, 9910–9916.
In schools of Germany, &c., 10,304–10,307.
Aid to, by Royal Navy, 10,424–10,441, 10,936–11,600.
One metropolitan museum for, 11,546.
Survey expedition, specimens of, 11,595–11,611, 12,097–12,103.
Naturalists for survey expeditions, 12,097–12,126.
Instruction in, in Scottish parochial schools, 12,423.
Fisheries, &c. under Board of Trade, 12,622–12,631.
At Queen's College, Galway, 13,156.
At Queen's College, Cork, 13,201.
At Queen's College, Belfast, 13,252, 13,316–13,347.

NATURAL HISTORY CLUBS.
Numerous local clubs, 3205.
At Cambridge, 5201–5204.
At Leeds, 6144.
At Huddersfield, 8983.

NATURAL HISTORY COLLECTIONS.
In British Museum, &c., 6492–6655, 6783, 7571–7582.
Cases opening at back for, 6717–6727, 6780.
In Germany, 10,083–10,114.
At Muséum d'Histoire Naturelle, Paris, 10,136–10,139.
At Leyden, 10,140–10,143.
Union of palæontological and recent specimens, 10,195–10,201.
Danger from fire of wet specimens, 10,195–10,201.
Trade collectors' specimens, 10,960.
From Patagonia, 13,348–13,356.
Studying of, by gaslight, 13,829.

NATURAL HISTORY MUSEUM (IRELAND).
Government of, &c., 9063–9066.

NATURAL PHILOSOPHY.
State aid to, 232.
At King's College, 6879.
Teaching of, 7878–7895.
At Edinburgh University, 9281–9461.
At St. Andrew's University, 9616, 9623, 9705–9758.
At Glasgow University, 9803–9932.
At Anderson's University, 9948, 10,031–10,046.
At Queen's College, Galway, 13,170–15,198.
At Queen's College, Cork, 13,233–13,237, 13,244.
At Queen's College, Belfast, 13,281–13,308.
At Catholic University of Ireland, 13,481–13,506.

NATURAL SCIENCE.
Lists of posts in, filled by men who have passed through the Physical Science School at Oxford, App. VII., Vol. I., page *31*.

NAUTICAL ASTRONOMY. See *Navigation and Nautical Astronomy*.

NAVAL ARCHITECTS.
Education, &c. of, 923–934, 1090–1101.

NAVAL ARCHITECTURE.
Scientific knowledge in relation to, 877–941, 9506, 9513, 11,280–11,352.
Increased study of, abroad, 923–934.
At Glasgow University, 9506, 9513.
Importance of scientific methods in, 11,280, 11,303.
Mr. Childers' committee on ships, 11,287–11,298.
Admiralty investigations relating to 11,298–11,352.
Superiority of France in, 11,304.
Constructor of Navy's department, 11,352.
See *Royal School of Naval Architecture*.

NAVAL COLLEGE.
Biological instruction at, 10,938, 10,957–10,961

NAVAL MUSEUM.
Models in, &c., 1153.

NAVIGATION AND NAUTICAL ASTRONOMY.
Examinations in, 839–856.
Best teachers of, 848–860.
In proposed science college, 5953.
In Plymouth Navigation School, 2053–2055.
In schools of science, 2809–2820, 2853–2855.
At Newcastle College of Science, 9154.
Main object of Greenwich Observatory, 10,524–10,528.
Under inspection of Board of Trade, 12,622–12,631.

NAVIGATION SCHOOLS.
At Hull, 845–864.
At Leith, 845, 870.
At Portsmouth, 911–922.
At Plymouth, 2051–2064, 2133.

NAVY. See *Royal Navy*.

NEILD, ALDERMAN.
Chemical professorship, &c., established by, 825.

NEWCASTLE.
As a centre for science teaching, 1667–1669, 2302–2466, 2925, 8757–8812.

NEWCASTLE COLLEGE OF PHYSICAL SCIENCE.
Aid of Durham University to, 8757–8761, 9151, 9198–9202.
Funds of, 8757–9251.
Accommodation for, 8759, 8819, 9193, 9216.
Employers of labour favourable to, 8762.
Students of, 8764–8822, 9164–9191, 9204–9233.
Examination at, 8764.
Professorships at, 8766–8840, 9195, 9210, 9251.
Lectures at, 8766–8772.
No religious test at, 8822.
Prospectus of, 9192.
Importance of, 9202–9207.
Evening classes desirable at, 9208, 9229–9235.
Purely scientific instruction in, 9223.

NEWCASTLE MEDICAL SCHOOL.
Examinations, laboratory, &c. at, 8783–8823.
Failure of boarding-house in connexion with, 8821.

NEW CODE. See *Revised Code*.

NEW COLLEGE (OXFORD).
Contributions of, for science, &c., 3283, 3472–3480, 3953, 4833.

NEWPORT.
As a locality for a mining school, 2510.

NEW YORK. See *Columbia College* (*New York*).

NEWTON, A., ESQ., M.A.
Evidence of, 4700–4818. Analysis of Evidence, Vol. II. App. page *177*.
Statement of, with regard to the Chair of Zoology and Comparative Anatomy in the University of Cambridge, App. II., Vol. II., 1, pages *1*, *2*.

NICHOLSON, MR.
Inventor of magenta, 5683.

NIGHT CLASSES. See *Science Classes*.

NORMAL SCHOOLS.
So-called, a fallacy, 1276.

NORRIS, REV. CANON.
Evidence of, 8465–8607. Analysis of Evidence, Vol. I. App. page *123*.

NORTHCOTE, THE RIGHT HON. SIR STAFFORD H., BART.
Evidence of, 13,622*a*–13,657. Analysis of Evidence, Vol. II. App. page *210*.

NORTH OF ENGLAND INSTITUTE OF MINING ENGINEERS.
Aid of, in establishing a mining school, 2385.

NORTHUMBERLAND.
High education of colliery viewers in, 2544, 2647.
Employers in, favourable to Newcastle College, 8757, 8762.

NORTHUMBERLAND, DUKE OF.
Offer of funds by, for a college of science at Durham, 8762, 8793.

NORWAY.
Meteorological work in, 14,117, 14,144–14,146.

NOTES ON PUBLIC EDUCATION.
Extracts from, App. V., Vol. I., page *8*.

NOVA SCOTIA UNIVERSITY.
Professors in, 5683.

O.

OBSERVATORIES.
Want of, for research, 3129–3166.
See *Kew, &c.*
Greenwich Observatory, 10,315–10,328, 10,681.
Wanted for physics of astronomy, 10,316–10,328, 10,441, 10,480–10,697, 11,599–11,993, 13,066–14,326.

Observatories—*cont.*
Kew Observatory, 10,318–10,324.
Under Meteorological Office, 10,329–10,349, 14,212–14,489.
In India, America, France, &c., 11,364–11,534.
At Madras, 11,893.
Wanted in Scotland, 12,413.
At Dublin University, 12,763–12,774.
Study of atmospheric electricity, 14,055.
Radcliffe Observatory, 14,115–14,122.
Astronomical, for meteorological work, 14,120, 14,160–14,169.
At St. Petersburg, 14,124.
Experimental, for meteorology, 14,483–14,489.
In United States, 1443.
Under Smithsonian Institution, 1517.

Ocean.
Oceanic meteorology, 14,048–14,553.

Office of Works.
And Jermyn Street Institution, 5985.
Scientific institutions under, 11,878.

Oldham.
Educational institutions in, 1795–1833, 1910, 1934.

Oldham, Professor.
Director of Indian Geological Survey, &c., 436, 757.

Ordnance Department.
Experiments of, 12,563.

Ordnance Survey.
Progress of, &c., 754, 12,256.

Organising Masters.
Under East Lancashire Union, 2166–2179.

Original Research.
Promotion of, by the State, 1364–1399, 2121, 3630, 7428, 10,511–13,636.
Connection of teaching with, 1399–1553, 2669–4226, 7421, 9515–10,361.
Promotion of, by Smithsonian Institution and Prof. Bache, 1407–1459.
In America, 1438–1465.
Connection of a science council with, 1665–1667, 12,344–12,646.
National laboratories and apparatus for, 2716–3545, 10,607–13,632.
At Oxford University, 2893–3261, 7897, 12,677, 13,674.
Promotion of, by British Association, 3109–3118.
On British rainfall, 3113–3116.
On the moon, 3116–3118.
Advantage of long vacation to, 3241.
At Cambridge University, 4329–5456, 7897, 10,742–10,770.
Importance of, for professors, &c., 5606–5611, 7165, 7421.
In College of Chemistry, 5682, 13,055–13,093.
Non-recognition of, in England, 5867, 11,053–11,062.
In Prussian universities, 5868.
At Owens College, 5882, 7422.
Competitive examinations inimical to, 5896.
At King's College, 6882–6961.
At University College, 7165–7168.
Best way of promoting, 7425.
High-class science schools would increase, 7428.
Dissertations on, for degrees, 7882, 7888, 11,815–11,819.
Fellowships, &c., for, 7897, 9515, 11,769–11,830, 12,300–12,305.
In industrial centres, 9174–9177.
At Edinburgh University, 9307–9428.
Universities should offer facilities for, 9435, 10,532.
At St. Andrew's University, 9777.
At Glasgow University, 9928.
In France and Germany, 11,053–11,062, 11,815–11,819, 13,054, 13,094–13,101.
Relating to naval architecture, 11,298, 11,352, 12,706–12,723.
Waste of national money in, 11,341–11,347.
In Navy Constructor's department, 11,352.
Patents should not be taken as, 11,487–11,496.
At British Museum, 11,537.
Pensions for, 11,831.
Government officers cannot pursue, 11,933.
At Woolwich Arsenal, 11,727, 11,948, 11,957.
At Kew, 12,190–12,194.
Public mind not educated to appreciate, 12,197.
State aid for, to educational institutions, &c., 12,207, 12,213, 12,237–12,244.
In astronomical physics, 12,279–12,283.
In physiology, 12,294–12,296.
By Scottish Meteorological Society, 12,404.

Original Research—*cont.*
By Scottish scientific societies, 12,423–12,443.
By Scottish working men, 12,423–12,428.
By Scottish universities, 12,443.
In connexion with agriculture, 12,530.
Not promoted by Oxford fellowships, 12,677.
Schools should be encouraged to develope, 12,696.
At Dublin University, 12,754–12,759, 12,782.
At Royal Irish Academy, 12,792–12,804.
At Queen's College, Belfast, 13,281–13,347.
At Catholic University of Ireland, 13,386, 13,396.
At Oxford Botanic Garden, 13,754.
Not undertaken by Meteorological Committee, 14,217, 14,287, 14,290.

Ornithology.
At British Museum, &c., 6593–6798.

Owen, Professor.
Evidence of, 6587–6656; 11,535–11,577. Analyses of Evidence, Vol. II. App. pages *134*, *198*.
Lectures of, &c., 6494, 6587–6591.

Owens College.
State aid for, 125, 7269, 7308–7318, 12,199–12,206.
Scientific instruction, &c. in, 125, 1401, 1667–1933, 2671–2869, 6001–6003, 7250–7431, 8769, 8774, 12,199–12,201.
Professorships in, 1401, 1779–1782, 2671–2869, 7331–7337, 7404.
Want of similar institutions, 1667–1669, 1775.
Artizans at, 1904, 7287–7350, 7411.
Scholarships in, 5882, 7289, 7409–7420.
Students at, 7251–7407.
Locality of, 7253.
Combination of literature and science in, 7254–7327.
Endowments, fees, &c. in, 7258–7263, 7298, 7364, 7384.
Evening classes in, 7292–7294.
Instruction for teachers in, 7295–7347.
No degrees at, 7351–7358.
Accommodation at, 7369–7383.
And Manchester Royal School of Medicine, 7376–7379.
Report to, on continental science schools, 7389.
Chemistry classes at, and colour shops, 7393–7401.
Original investigations in, 7422.
Systematization of instruction in, by Professor Huxley, 7431.
Newcastle College should become like, 8769, 8774.

Oxford.
Influence of scientific institutions at, 2924–2927.
Meteorological observations at, 14,021–14,128.

Oxford Botanic Garden.
History, &c, of, 13,754–13,810.

Oxford Museum. See *Oxford University*.

Oxford Physical Science School.
List of posts in Natural Science filled by men who have passed through the, App. VII., Vol. I., page *31*.

Oxford University.
Geology at, 687, 2943, 3201.
Scientific instruction at, 2877–4876, 7835, 7897, 7899, 10,929, 13,586–13,815.
Museum of, 2879–2963, 3106, 3620.
Students of, 2888–4878.
Tendency to science at, 2885–2889, 3532, 3583, 3676, 3687.
Professors of, 2893–4226.
Original research at, 2893, 2913, 2947, 3022–3054, 3483–3557.
Degrees of, 2895–3704, 3534, 3755–4084, 4849–4876.
Fellowships of, 2906, 3032–3041, 3505–3552, 3608–4217.
Lectures at, 2916–2919, 3172.
Assistant professors, demonstrators, &c., for, 2941–2947, 3334–3346, 3489–3494, 3833, 3995–4076.
Baroness Burdett Coutts' scholarship at, 2943.
Scholarships at, 2943, 3194–3199, 3314–3421, 3801–3806, 3890–4217.
Technical education at, undesirable, 2950, 3042, 3481.
Might prepare illustrations for teaching, 2966–2970.
Physics at, 2978–3093, 3168–3170, 4153, 4158, 4165.
Science lecturers at, 2997.
Colleges at, 2997–3047, 3190, 3230, 3247, 3306–4863, 7897.
Examinations at, 3000–3088, 3275–3448, 3755–4848.
Ladies at, 3178.
Physiology at, 3211–3239, 3261.
Science taught in colleges at, 3230.
Insufficiency of teachers in, 3238, 3242*a*.
Human anatomy at, 3238.
Laboratories, apparatus, &c. at, 3282, 3322–3326, 3892, 3896, 3965.

Oxford University—*cont.*
Funds of, 3290–3303, 3403*a*–3407.
Benefactions to, 3291.
Engineering at, 3329–3429.
Professorships at, 3330–3560, 3601–3608, 3807–3818, 4080, 4189, 4208, 4857, 4859.
Matriculations at, 3461, 3536–3573, 3613.
Astronomy at, 3477.
Ecclesiastical element at, 3519.
Libraries, museums, &c. at, 3588, 3649, 3650.
Elections at, 3601–3607.
Headships of colleges at, 3608.
Chemical teaching at, 3621, 3654–3658.
Greek at, 3754, 4128, 4855, 4875.
Large sums spent for science at, 3787.
Board of studies at, 3835.
Change in system of education at, 3890.
Schools at, have become honour schools, 3988.
Mineralogy and crystallography at, 4090–4143.
Honours at, 4107, 4123–4143.
Sanscrit at, 4135.
Character of, is literary, 4844.
Introduction of science into, 7255.
Hierarchy of offices for, 13,658–13,752.
Governing bodies of colleges at, 13,737–13,739.
Proposals for improvement of, 13,752.
Botany at, 13,753–13,815.
Endowments and parliamentary grants, App. VI., Vol. I., pages *9–14*.
Information respecting fellowships at the several colleges, App. VI., Vol. I., pages *25–30*.
Correspondence between Her Majesty's Commissioners and the Heads of Colleges and Halls in the, App. VI., Vol. I., pages *9–31*.

Oxford University Commission.
Work of, 3212, 3608, 3680, 4053, 4114.

P.

Palæontology.
Essential for a school of mines, 691, 2473.
At British Museum, 6593–7245, 10,195–10,201.
At new natural history museum at South Kensington, 6681–7208.
At Kew, 7244.
Interpolation of fossil with recent specimens, 7769–7771.
At Glasgow University, 9797–9799.

Paris. See *France*.

Parliament.
And national museums, 6597, 9055–9131.
And University of London, 7132.
And University College, 7133.
And existing endowments, 13,509.
And a science council, 13,528, 13,534, 13,564.
And Government Grant Committee, 13,530.

Parliament, Acts of.
For re-distribution of college revenues, 3417–4971, 5060–5586, 9720–9722.

Parliamentary Committees.
Scientific evidence given in, 11,074–11,081.

Parliamentary Votes.
For science for the middle and upper classes in 1867–68, exclusive of the cost of the Queen's Colleges in Ireland, App. II., Vol. I., page *5*.

Patent Museums.
Objection to museums specially for patents, 13,848, 13,857.

Patent Office Museum.
Collections, &c., of, 1155, 9065–9141, 13,845–13,857.

Patents.
Patented inventions in museums, 10,590, 10,668–10,670.
Originated in Government establishments, 11,487–11,496.
Laws for, 11,771, 11,781–11,788.

Pathology.
At Edinburgh University, 9264, 9281, 9284.
At St. Andrew's University, 9629.
At Brown Institution, 12,323.

Pattison, Rev. Mark, B.D.
Evidence of, 3751–3888. Analysis of Evidence, Vol. II. App. page *93*.
On Oxford Fellowships, 4087.

Payments on Results.
For science teaching, 2, 7, 16, 32, 149, 283–342, 1613, 1615, 1902–2128, 2142–2254, 2300, 5901, 5947, 6082–6478, 8213–8286, 9593–9595.
For artisan class, 2, 6445.
Estimate for, 7.
As affecting teachers, 16, 32, 283, 5962–6424.
Appropriate to elementary education, 1615.
In Oldham, 1902.
To teachers of trade schools, 2021–2023, 6381–6387.
In Plymouth schools, 2064, 2093, 2128.
Not for dockyard pupils, 2076.
Under East Lancashire Union, 2142.
Cramming for, 2246–2254, 6103.
The only state aid to technical schools, 2300.
Made on reports of inspectors of Education Department, 5901.
At Bristol Trade School, 5947, 6381–6387.
Errors of Professor Jenkin respecting, 6082.
Misconception of Mr. Samuelson respecting, 6089–6098.
Returns of, 6099.
In Yorkshire, 6141–6143.
Unsatisfactory system of, 6170–6172.
For children of labouring poor, 6445.
All classes should be eligible for, 6445.
None for laboratory work, 6468–6478.
Extension of, to higher subjects, 8213.
In Scotland, 9593–9595.

Payments.
On results and fees of students in science schools under the Science and Art Department, comparison of the, App. XVIII., Vol. I., page *56*.

Peel, Sir Robert, the (late).
Interest taken in science by, 466.

Pensions. See *Superannuation*.

Per-centages.
Of results in Department science examinations, 766, 6086–6088, 6104.
Of best boys in Oldham schools, 1916–1919.
Of subjects in Plymouth science schools, 2064, 2068, 2122.
Of results under East Lancashire Union, 2155.
Of papers of original research, 5866.

Percy, Dr., F.R.S.
On inadequate accommodation at School of Mines, 47, 469, 482, 539, 2472–2476.
His lectures, laboratory, &c., 365, 469, 539.
Certificates of, accepted in Indian mints, 496.
Assistant examiner in School of Naval Architecture, 1080.

Perkin, Mr.
Discoverer of aniline colours, 5682.

Petition.
Of the Council of the Geological Society of Edinburgh, App. XV., Vol. II., page *70*.

Pettenkofer, Professor.
On German gymnasia, &c., 3743.

Pharmaceutists.
At Bristol Trade School, 6337.
How considered by Science and Art Department, 6382.

Pharmacy.
At Edinburgh University, 9284.

Phelps, Rev. R., D.D.
Evidence of, 5592–5666. Analysis of Evidence, Vol. II. App. page *131*.

Philadelphia Academy.
Not supported by State of Pennsylvania, 1530.

Phillips, Professor John, M.A.
Evidence of, 3100–3209. Analysis of Evidence, Vol. II. App. page -

Philology.
Promotion of, by Smithsonian Institution, 1407, 1488.

Philosophical Instrument Makers.
Their ignorance of mathematics, 10,494.
Donations of, to South Kensington Museum, 13,834.

Philosophical Society of Bradford. See *Bradford*.

Philosophy, Natural and Experimental.
State aid to, 115.

PHOTOGRAPHIC OBSERVATIONS.
- Of the sun, &c., 10,318–10,321, 11,354–11,528, 11,599, 13,066–13,073, 14,023, 14,115–14,539.
- At Kew Observatory, 10,318–11,528.
- At Greenwich Observatory, 11,599, 14,023.
- In India, Mauritius, &c., 14,023.
- At Radcliffe Observatory, 14,115–14,122.
- At all important astronomical observatories, 14,160–14,163.
- Volunteer observers could not undertake, 14,530.
- For meteorology, 14,532–14,539.

PHYSICAL ASTRONOMY. See *Astronomy*.

PHYSICAL GEOGRAPHY.
- For children, 319, 355, 358, 2276, 3736, 5922.
- In elementary schools, 355, 5922, 7926, 7982, 8311, 8316, 8359.
- At Oxford University, 3383, 3411, 3781.
- For degrees, 3781.
- Crystallography essential to, 4100–4107.
- Essential to chemists, 4132.
- At Cambridge University, 4232–5405.
- Euclid essential to, 4267.
- Chemistry as an application of, 4267–4270.
- For university degrees, 4314.
- In public schools, 4451.
- In Indian Civil Service examinations, 5237.
- Teachers of, 5908, 5941, 6422–6424, 7795.
- Estimate for, 5953.
- Expense of, in proposed science college, 5953.
- Laboratory for teaching, 5995, 6351.
- At Bristol Trade School, 5945.
- At Jermyn Street and South Kensington Institutions, 6108.
- Class on, for schoolmistresses, 6161, 6165.
- Subject for cramming, 6196, 6198.
- At King's College, 6883–7030.
- At King's College School, 6920.
- Instruction in, should be under one professor, 7404.
- Many students pass in, 7926, 7982–7984.
- At Abbott's Ann School, 8311.
- In rural schools, 8311, 8316.
- Under New Code, 8377.

PHYSICAL OBSERVATORY.
- Communications from Colonel Strange and Professor Cayley, respecting the proposed establishment of a, App. VII., Vol. II., pages *27–31*.

PHYSICAL SCIENCE SCHOOL AT OXFORD.
- List of posts in Natural Science filled by men who have passed through the, App. VII., Vol. I., page *31*.

PHYSICISTS.
- Contrasted with mathematicians, 1666.

PHYSICS.
- Instruction in, for children, 355, 3056, 3059, 3719, 4303, 6371–6373.
- At School of Mines, 365, 2434, 5996–5998.
- At School of Naval Architecture, 943, 1005.
- Lectures on, by Astronomer Royal, 943, 1005.
- Under Smithsonian Institution, 1407–1520.
- Physical cabinets in United States, 1519.
- At Oxford University, 2895–4214.
- And mathematics and mechanics, 3062–3064, 4266, 4296, 4308.
- At University College, 7134, 7150, 7779–7853.
- At University College School, 7144–7155.
- Essential to geology, 7625–7628.
- Little demand for, in practical life, 7792, 12,884.
- Importance of practical instruction for, 7798.
- At Newcastle College of Science, 9153.
- At Glasgow University, 9506, 9511.
- At St. Andrew's University, 9709.
- At Anderson's University, 10,065.
- State laboratories and observatories for, 10,350–13,065.
- Provision for physical astronomy, 11,599, 11,627, 13,066–13,124.
- Laboratory for Standards' Department, 11,749–11,751.
- At Dublin University, 12,746–12,857.
- Importance to, of accurate experiments, 12,882.

PHYSIOLOGY.
- State payments for, 115.
- Examinations in, 254–275, 6258–6262.
- Cramming for, 265.
- Teaching of, 266, 2260–2266.
- For children, 349–356.
- Meaning of term, 2880, 3211.
- At Oxford University, 2979–4165.
- Anatomy taught separately from, 3238–3240.

PHYSIOLOGY—*cont.*
- Mathematics essential for, 4122.
- For botanists, 4132.
- At Cambridge University, 4386–5354.
- At proposed college of science, 5953, 6000.
- Professor Huxley's text-book on, 6264–6266.
- At College of Surgeons, 6853.
- At King's College, 7028–7030.
- Under New Code, 8377.
- In Birkbeck schools, 8739.
- At Edinburgh University, 9264, 9312, 9373.
- At Glasgow University, 9600, 9857, 9932.
- At St. Andrew's University, 9632–9637.
- And chemistry and physics, 9808, 12,294–12,296.
- Thermometers for, 10,433.
- Laboratories and apparatus for, 10,434–12,337.
- At Hunterian Museum, 11,537, 11,566.
- Connection of, with medicine, 12,294–12,343.
- Impediments to research in, 12,297–12,301.
- Teaching of, in medical schools, 12,335–12,343.
- In Ireland, 13,386–13,388.

PIMLICO.
- Artizans' school in, 1956, 2005.

PLANTS.
- For teaching and examinations, 4893–4909, 4922.

PLATT, MR.
- Science schools built by, 1804, 1825.
- Manufacture of iron by, 1857–1879.

PLAYFAIR, DR. LYON, F.R.S.
- Respecting College of Chemistry, 452, 5667.
- Attention paid to agricultural chemistry by, 469.

PLYMOUTH.
- Department examinations in, 6442.

PLYMOUTH SCIENCE SCHOOLS.
- Charles School, Navigation School, &c., 2047–2135.

POLITICAL ECONOMY.
- Not applicable to education, 6007–6019.

POLLUTION OF RIVERS COMMISSION.
- Saving expenses of, 5768.

POLYTECHNIC SCHOOLS.
- In Germany, 1584, 1755, 2330.
- Reaction in, against teaching mechanical arts, 1673–1676.

POMERANIA.
- State laboratory in, 10,835.

PORTER, MR.
- On teaching geometry to carpenters, 6085.

PORTSMOUTH.
- Science teaching at, 911–922, 988.

POTTERY DISTRICTS.
- Chemistry class formerly in, 8489, 8509–8513.

PRACTICAL ART DEPARTMENT. See *Department of Practical Art*.

PRACTICAL INSTRUCTION IN SCIENCE.
- Importance of, 275–1076, 1279, 1343–1351, 1581–1687, 1824–1853, 2154–3967, 4210–4802, 6478–6481, 9246.
- Given by teachers, 275, 2260–2266, 4888–4930, 5906–5917, 6245–6256, 9599.
- At School of Mines, 296, 473–518, 656, 690, 710–712, 2336–2341.
- Early practical instruction, 320, 606, 1824, 1851.
- In Germany, 320, 1945, 2410–2414, 5273.
- In geology, 590–712.
- Shown in Science and Art Department examinations, 601, 616, 4902–4931, 6241–6317, 6480, 8904.
- In relation to theoretical, 709, 936–960, 1065, 1676–1687, 2410–2414, 3580, 4594, 5207, 9509, 11,328–11,332.
- Of Admiralty students, 905–910, 953, 983–985.
- Abroad, 933.
- In France, 954–956.
- At Portsmouth, 988, 990.
- At School of Naval Architecture, 1076.
- In metallurgical laboratories, 1346–1351.
- At Chatham, 1604–1612.
- Under East Lancashire Union, 2154.
- Little encouragement for giving, 2154.
- Dr. Foster on practical teaching of physiology, 2155.
- In Cornwall, 2410–2414.
- As regards mining, 2421–2530.
- In Belgium, 2630.
- In Glasgow University, 2698–2713, 9506–9511, 9601, 9796–9857.

Practical Instruction in Science—*cont.*
At Oxford University, 2886–3478, 3964–3967, 4210, 4165, 7835.
Hospital study for Oxford students, 3964–3967.
At Cambridge University, 4589–5310.
In botany, 4902–4931.
In science schools for industrial centres, 5109, 5127–5129, 5207, 5245.
For Whitworth examinations, 5244–5252, 6979.
In Yorkshire, 6136–6140.
In mechanics' institutes, 6136–6140, 9017–9028.
Written examinations not a test of, 6244, 6252.
In Bradford science classes, 6257.
Payment on results should be increased for, 6284–6317.
In Bristol Trade School, 6330, 6360, 6412.
At King's College, 6883–7039.
At King's College School, 6920, 7033.
In engineering, 6933–6980, 7843, 9178–9187.
At University College, 7134–7164, 7823.
At University College School, 7144–7151, 7816–7820.
In continental schools of science, 7384, 7389.
In physics, 7798.
For London University degrees, 7832–7835, 7885–7887.
Under Education Department, 8067.
Under British and Foreign School Society, 8204.
Not enforced by Endowed Schools Commission, 8251–8261.
At Newcastle, 8805–8811.
At Leeds, 8862–8865.
Under Society of Arts, 9004.
College and other workshops for, 9186–9246.
At Edinburgh University, 9264–9502, 10,203–10,206.
Edinburgh as a locality for, 9502.
At St. Andrew's University, 9625, 9695–9701, 9765.
For Scottish schoolmasters, 9695–9701.
In Glasgow Astronomical Observatory, 9902–9909.
At Anderson's University, 9950–9956, 10,026.
In schools, 10,061–10,063.
At Dublin University, 12,831–12,921.
At Queen's College, Galway, 13,139–13,156.
At Queen's College, Cork, 13,201, 13,217–13,219, 13,245.
At Queen's College, Belfast, 13,266, 13,338–13,344.
At Catholic University of Ireland, 13,428.

Prælectors.
At Cambridge, 4996–4998, 5020, 5039, 5049, 5078.
Exemption of, from celibacy restriction, 5049.

President of the Committee of Council. See *Lord President.*

Price, Rev. B., M.A.
Evidence of, 3268–3462. Analysis of Evidence, Vol. II. App. page *84*.

Primary Schools. See *Elementary Schools.*

Prime Minister.
Scientific investigators should be appointed by, 13,610.

Principals of Colleges. See *King's College* (*London*), &c.

Printing of Scientific Papers.
Great amount done for Greenwich Observatory, 10,488.
See *Scientific Publications.*

"Privat-docenten."
In German universities, 1268, 7846.
Desirable in England, 7846.

Private Adventure Schools.
State aid to science in, 6447–6451.

Privy Council Office.
Analyses for, 5772.

Prizes.
For elementary science schools, 2, 7, 767, 1809–1816, 1899.
State payments for, 7.
At College of Chemistry, 5714.
At St. Andrew's University, 9644.
See *Exhibitions. Fellowships. Scholarships.*

"Professores Extraordinarii."
In German universities, 1554, 2941–2946.

Professors.
At Smithsonian Institution, 1466.
In America, 1506–1553.
In France, 1506–1553, 10,099–10,189.
In Germany, 1554, 2941–2946, 7846, 10,099–10,189, 11,392–11,394.
"Extraordinary professors" in Germany, 1554, 2941–2946.

Professors—*cont.*
At Glasgow University, 2656–2864, 9571–9909, 12,266–12,290.
Original research by, 2669–3184, 9335, 9845–9856, 10,049–10,881, 11,093, 11,756, 12,207–12,244, 13,231.
At Oxford University, 2890–4226, 13,658–13,752.
Retiring allowances for, 3347, 3392, 3460.
Lecturing by, 3495, 12,207, 12,237–12,244.
Endowment for, 3512, 3553.
Should not give elementary instruction, 3569–3573.
Election of (see *Election of Professors, &c.*).
At Cambridge University, 4227–5665, 10,501.
In relation to number of students, 4293, 9563.
Classes of, at British Museum, 6595–6597.
At King's College, 6882–7070, 7083–7712.
At University College, 7132–7178, 7807–7812, 7854–7857.
Better payment of, 7657, 7676–7680, 7697, 11,862.
At Newcastle College of Science, 8761–8769, 9210, 9251.
At Edinburgh University, 9341–9482, 10,202–10,205.
Edinburgh a great training school for, 9314.
Advantage to, of access to workshops, 9550.
Should not do professional work for an income, 9600.
At St. Andrew's University, 9616–9788.
Assistants in universities training for, 9826.
At Anderson's University, 9942–10,049.
Regius Professor and Science and Art Museum, 10,207–10,289.
Should receive State aid as well as fees, 11,392–11,394, 12,207, 12,237–12,244.
At Conservatoire des Arts et Métiers, Paris, 11,656.
At Dublin University, 12,730–12,960, 13,170–13,176.
At Queen's College, Galway, 13,170–13,176.
At Queen's College, Cork, 13,201, 13,232–13,244.
At Queen's University and Colleges in Ireland, 13,216.
At Queen's College, Belfast, 13,256–13,360.
At Catholic University of Ireland, 13,364–13,506.

Professors of Method.
Desirability of having, 7334–7337.

Professorships.
Endowment of, 686–691, 1604–1779, 2676–2741, 3171, 3330.
At Glasgow University, 2656–2759, 12,266–12,290, 9797–9886.
For natural history, in Scotland, 2741–2743.
For technical science, 2818, 2842–2857.
At Oxford University, 2912, 3082, 3211–4209, 4837, 4857. 4859, 13,658–13,737.
Election to, 3240–3267.
Wanted for biology, 3261.
Superannuation for (see *Superannuation*).
Wanted for mineralogy, 4113.
At Cambridge University, 4243–5648.
Attachment of, to fellowships, 4730–4734, 5564.
At King's College, 7013, 7681–7688.
At University College, 7170.
Government should found, 7425–7429, 11,354–12,244.
At Newcastle College of Science, 8766–9195.
At Edinburgh University, 9269–9611, 12,482.
At St. Andrew's University, 9625–9790.
At Anderson's University, 9985–10,065.
In Germany, 10,922.
At Dublin University, 12,730–12,959.
At Queen's College, Belfast, 13,252, 13,316–13,347.
At Catholic University of Ireland, 13,426.
Difficulty of Catholics in obtaining, 13,492.

Prussia.
Practical teaching in, 320, 2411.
Mining schools and students in, 2325–2328, 2411, 2456.
Mines in, 2326.
State endowment of mining schools, 2456.
Universities in, 5792, 5868.
Degrees in, 5868.
Original research in, 5868.
See *Germany.*

Public Education.
Extracts from Notes on, App. V., Vol. I., page *8*.

Public Schools. See *Schools.*

Pupil-teachers.
As affected by Revised Code, 7930–8357.
Science teachers serving apprenticeship as, 8844–8940.

Purser, John, Esq., M.A.
Evidence of, 13,250–13,315. Analysis of Evidence Vol. II. App. page *184*.

Pyx, Trial of the.
For the Royal Mint, 11,656, 11,751, 11,753.

Q.

QUEEN'S COLLEGE, BELFAST.
  Promotion of science at, 13,250–13,360.
  Statement respecting, App. V., Vol. II., pages *17*, *18*.

QUEEN'S COLLEGE, CORK.
  Promotion of science at, 13,200–13,247.
  Statement respecting, App. V., Vol. II., page *18*.

QUEEN'S COLLEGE, GALWAY.
  Promotion of science at, 5683, 13,138–13,198.
  Statements respecting, App. V., Vol. II., pages *18*, *19*.

QUEEN'S COLLEGE (OXFORD).
  Contribution of, for science, 3283.

QUEEN'S UNIVERSITY IN IRELAND.
  Instruction, &c. at, 13,204–13,479.
  Statements respecting the several Colleges thereof, App. V., Vol. II., pages *17–19*.

QUEENWOOD COLLEGE.
  Teaching of chemistry to boys at, 5859.

R.

RADCLIFFE LIBRARY (OXFORD).
  Its great value, &c., 2881–3600.

RADCLIFFE OBSERVATORY (OXFORD).
  Its publications, &c., 3596–3653.

RADCLIFFE TRUSTEES (OXFORD).
  Grants for science by, 3596–3600.

RADNOR, EARL OF.
  Patron of first Birkbeck school, 8725.

RAILWAYS.
  Competition respecting, 1695.
  Relation of Board of Trade to, 12,622–12,631.
  American Government publications relating to, 1542–1544.

RAINFALL.
  Observations on, by Dr. Miller and Mr. Symons, 3113–3116, 13,940–13,947.
  Government aid wanted for observations on, 3113–3116.
  Planting of forests to secure, 12,508.
  Meteorological Office and observations on, 13,940–13,947, 14,059.
  British rainfall organization, 13,940–13,947.
  British Association and observations on, 13,940–13,947.

RAMSAY, PROFESSOR, LL.D.
  Evidence of, 567–757. Analysis of Evidence, Vol. I. App. page *73*.
  Lectures on geology by, 365.

RANKINE, PROFESSOR, LL.D.
  Evidence of, 9504–9568. Analysis of Evidence, Vol. II. App. page *171*.
  His class on naval architecture, &c., 925, 1080, 1804, 1903.

RAWLINSON, MAJOR-GENERAL SIR H. C., K.C.B.
  Evidence of, 12,548–12,619. Analysis of Evidence Vol. II. App. page *205*.

RAY CLUB.
  At Cambridge, 5201–5204.

READERS. See *Lee's Readerships*.

"REALGYMNASIA." See *Gymnasia*.

"REAL SCHULEN." See *Gymnasia*.

REED, E. J., ESQ., C.B., M.P.
  Evidence of, 12,705–12,729. Analysis of Evidence, Vol. II. App. page *206*.
  Examiner for naval architecture, &c., 1080.

REEKS, TRENHAM, ESQ.
  Evidence of, 359–566, 13,816–13,831. Analyses of Evidence, Vol. I. App. page *70*, and Vol. II. App. page *144*.

REGISTRAR-GENERAL.
  Observations, publications, &c., of, 12,387–14,553.
  And the Scottish Meteorological Society, 12,387–14,323.
  And the Meteorological Office, 12,505–14,538.

REGISTRATION OF MORTALITY.
  More complete registration wanted, 10,646–10,653.

REGIUS PROFESSORSHIPS.
  As to abolition of, 129, 136, 1301–1305.
  None in Glasgow University, 2744–2752.

REID, GENERAL.
  Bequest of, for chair of music, 9276–9281.

RELIGION.
  At Cambridge University, 4373, 5044, 5048, 5636–5649.
  Science for clergymen engaged in tuition, 4478–4526, 5651.
  At King's College, 6986–7027, 7636–7710.
  London University degrees exempt from, 7132.
  At Newcastle College of Science, 8822.
  At Edinburgh University, 9276, 9459.
  Science for students of Presbyterian bodies, 9460.
  At Glasgow University, 9577, 9859.
  At Andersonian University, 9593.
  At Mechanics' Institution in Glasgow, 9593.
  At St. Andrew's University, 9624, 9695.
  Instruction in physiology and hygiene for theological students, 9632–9637.
  At Catholic University of Ireland, 13,362–13,423, 13,506.
  Educational impediments of Irish Catholics, 13,440–13,479.
  Restricted career in science for Roman Catholics, 13,440–13,479, 13,492.

"RÉPÉTITEURS."
  In colleges of France, 1268.

REPORTS.
  On School of Naval Architecture, Vol. I. page 66.
  On Oldham schools, 1806–1814.
  On German laboratories, 7385.
  On continental science schools, 7389.
  On standards, 11,656.
  Of Science and Art (Ireland) Commission, 13,858.
  For 1867 and 1868 of the Committee of Governors of the Worcester, Lichfield, and Hereford Training College, extracts from the, App. XVI., Vol. I., pages *47*, *48*.
  From Examiners under the Science and Art Department, App. XVII., Vol., I., pages *48–56*.

"RESPONSIBLE REPORTS."
  Meaning of, as applied to appointments, 1193.

RESEARCH. See *Original Research*.

RESOLUTIONS.
  Passed at the last meeting of the Commission, App. IV., Vol. III., page *6*.

RETIRING ALLOWANCES FOR PROFESSORS, &c. See *Superannuation*.

REVENUES. See *Income and Expenditure*.

REVENUE DEPARTMENT. See *Inland Revenue Department*.

REVISED CODE.
  As affecting science teaching, &c., 315, 2151, 2278, 2286, 6123, 6225, 6445–6461, 8164–8623.
  Science teaching, &c. under, 8213, 8219, 8367–8463, 8607–8720.
  Will promote higher subjects, 8219.
  As affecting intelligence of children, 8614.

RIBBON WEAVERS OF BASLE.
  Scientific knowledge of, 2010.

RICHARDS, REAR-ADMIRAL G. H., C.B.
  Evidence of, 11,578–11,654. Analysis of Evidence, Vol. II. App. page *199*.

RICHARDSON, WILLIAM, ESQ.
  Evidence of, 1788–1936. Analysis of Evidence, Vol. I. App. page *90*.

RICH, LADY.
  Promotion of scientific instruction by, 8496, 8498.

RIGG, REV. J. H., D.D.
  Evidence of, 8032–8099. Analysis of Evidence, Vol. I. App. page *118*.
  His technical school at Chester, 5213.

ROBINSON, REV. CANON, M.A.
  Evidence of, 8207–8286. Analysis of Evidence, Vol. I. App. page *120*.

ROBSON, JOHN, ESQ., B.A.
  Evidence of, 7129–7158. Analysis of Evidence, Vol. II. App. page *150*.

ROLLESTON, GEORGE, ESQ., M.D.
  Evidence of, 3210–3267, 3691–3750. Analysis of Evidence, Vol. II. App. page *82*.

ROME.
  Astronomy, spectroscopy, &c. in, 11,529.

ROSCOE, H. E., ESQ., B.A.
  Evidence of, 7363–7439. Analysis of Evidence, Vol. II. App. page *161*.

Royal Agricultural College, Cirencester.
Professors in the, 5683.

Royal Astronomical Society.
Resolution passed by the Council of the, respecting the proposed establishment of a Physical Observatory, App. VII., Vol. II., page *31*.

Royal College of Chemistry.
Instruction at, 13, 38–48, 85–98, 399–557, 766–792, 2476–2491, 5683–5853, 7364, 13,055, 13,074–13,093.
Education of teachers at, 13, 778–792, 5688–5693, 5847.
Fusion of, with proposed college of science, 42–49, 5847–5853, 6035.
Want of accommodation at, 46, 416, 538, 784, 2476–2493, 5683, 5732, 5836.
Origin, staff, progress, &c., 85–90, 5667–5684.
Connection of, with Royal School of Mines, 85–90, 97, 399, 414, 452–457, 505, 2491, 5836–5841, 5848, 13,055, 13,074–13,093.
The laboratory of the Royal School of Mines, 399, 414.
Inland Revenue and Telegraph officers at, 516–550, 5831.
Examinations at, 766.
Students of, 5685–5687, 5781–5787, 5817.
South Kensington as a locality for, 5701–5704, 5752.
Evening lectures in connexion with, 5705–5713.
Fees at, 5823, 7364.
Original research in, 13,055, 13,074–13,093.
See *Royal School of Mines.*

Royal College of Science, Dublin.
Scientific instruction at, 2, 18, 283, 5683.

Royal College of Surgeons. See *Hunterian Museum.*

Royal Commission on Coal.
Service rendered to, by Geological Survey, 703–705.

Royal Commission on Standards.
Reports, &c. of, 11,656, 11,668.

Royal Dublin Society.
Its museum, &c., 9055–9066, 12,819–12,959.

Royal Engineers.
As inspectors of science and art schools, 5928–5936.

Royal Exhibitioners.
At Royal School of Mines, 390–446.

Royal Geographical Society.
Its advice to Government, prizes, journals, &c., 12,548–13,646.

Royal Hibernian Academy.
Its management, &c., 9055–9066.

Royal Institution.
A model institution, 1551.
Lecture at the, on British Museum collections, 6953.

Royal Irish Academy.
Publications, &c. of, 3126, 9055–9066, 12,792–12,804.

Royal Mint.
New standard trial plates for, 11,656–11,753.

Royal Navy.
Aid to meteorology, biology, &c. by, 10,424–10,441, 10,936–11,600, 14,343–14,350.
Representation of, in a science council, 12,046, 12,086.
Aid to, by Meteorological Committee, 13,891–13,903, 14,212, 14,490.

Royal Observatory, Edinburgh.
Statement respecting the, by Professor Piazzi Smyth, App. V., Vol., II. pages *14–16*.

Royal Observatory (Greenwich). See *Greenwich Observatory.*

Royal School of Medicine, Manchester.
Attachment of, to Owens College, 7376–7379.

Royal School of Mines.
Scientific instruction at, 2–759, 1108–2592, 4809, 5677–7629, 8521–9163, 10,925–10,929, 11,751.
Students of, 18, 283–742, 1108–1113, 2333–2462, 5839, 7442–7447.
Scholarships in, 18, 6342.
Relation of, to Science and Art Department, 19.
Education of teachers in, 38–40.
Proposed fusion of, in a college of science, 42–45, 241, 6035.
Want of accommodation at, 46, 400–402, 2472, 5734, 7441–7447.
Professors of, 72, 420–422, 486–492, 751.
Connection of College of Chemistry with, 88–90, 399, 452–457, 2488–2491, 5677, 5819.

Royal School of Mines—*cont.*
Origin, title, object of, &c., 100–112, 361–398, 452–457.
Associates of, 283.
Want of mathematics at, 296–299, 427–451*a*, 2422, 2524, 6425.
Management of, 360.
Appointments from, 434–530.
Cost of, 443–451, 7364.
Fees in, 484.
Connection of, with Geological Survey, 551, 732, 5848.
Protest against breaking up of, 2469.
As a model for colonial schools of mines, 2471.
Evening lectures to working men, &c. at, 5705–5713.
Want of schools between elementary schools and, 8521.
Metallurgical experiments at, 11,751.

Royal School of Naval Architecture.
Its origin, teaching, students, &c., 13, 227, 336, 876–2083, 5735–6047, 1029–1032, 1164, 11,315–11,332.
Connection of, with Admiralty, 876–884, 1029.
Cost of, &c., 902–904.
Not appreciated by naval architects, &c., 928.
Scholarships and free studentships at, 1035–1037.
Examinations at, 1038–1040.

Royal Society.
As scientific adviser of Government, 1209, 1212, 3126–3161, 3541, 7223–7238, 7418, 9558–13,650.
Government Grant Fund administered by, 1284–1289, 1391, 10,898–13,608.
Aid given to Kew by, 3109.
Grant by, for spectroscopic sun observations, 10,318.
Connection of, with Meteorological Office, 10,329–10,349, 12,639–12,666, 13,864–14,214.
Catalogue of Scientific Papers of, 10,603, 11,183–11,197.
New standard yard constructed by, 11,656.
Correspondence with the President of the, respecting the Government Grant in aid of scientific research, App. XI., Vol. II., pages *41–62*.

Royal Society of Edinburgh.
Aid to science by, &c., 3126, 12,425–12,500.
Memorial of the Council of the, App. XIV., Vol. II., pages *67–70*.

Rugby School.
Science teaching at, 3697, 4629.

Rumney Scholarships.
In Owens College, 7412.

Rural Schools.
Science teaching, &c. in, 7931–7933, 8287–8312.

Russell, Mr. Scott.
Connection of, with School of Naval Architecture, 1028, 1080.
On teaching pure mathematics, 8471.

Russia.
Meteorological science in, 10,339, 14,020 (App. B).
Paid academies of science in, 10,521.
Sun-photographs taken in, 11,354–11,528.
Important physical laboratory in, 14,124.

S.

Sabine, General Sir E., R.A.
Evidence of, 11,109–11,274. Analysis of Evidence, Vol. II. App. page *195*.
Correspondence of Her Majesty's Commissioners with, respecting the government grant to the Council of the Royal Society in aid of scientific research, App. XI., Vol. II., pages *41–62*.

Saint Andrew's University.
Scientific instruction in, 9615–9770.
Statement with regard to endowments and parliamentary grants, App. V., Vol. II., page *5*; as to connexion with Dundee, page *6*.

Saint John's College (Cambridge).
Promotion of science at, 4326–7902.

Saint Mark's College (Chelsea).
Foundation, students, scientific instruction, &c. at, 7903–8013.

Saint Peter's College (Cambridge).
Taxation for University at, 5109.

Salaries of Professors, Teachers, &c.
In Oldham, 1804, 1813, 1862, 1866, 1928.
In Glasgow University, 2659–2772.
In proposed council of science, 3144.
At Oxford University, 3214–4150.
Should be increased, 11,756–11,863.
See *Income and Expenditure.*

Sales, H. H., Esq.
Evidence of, 6113–6235. Analysis of Evidence, Vol. I. App. page *108*.
Memorandum by, on the progress of scientific instruction in Yorkshire, App. XI., Vol. I. pages *39–41*.

Salisbury, The Most Hon. R.A., Marquess of.
Evidence of, 13,552–13,622. Analysis of Evidence, Vol. II. App. page *209*.
Intention of, regarding scientific instruction, 2.

Samuelson, Bernhard, Esq., M.P.
Reference to Committee of, 373, 516, 2469–2485.
On works at Creuzot, 1969.
On payment for results, 6089–6098.

Sanderson, J. S. B., Esq., M.D.
Evidence of, 12,292–12,356. Analysis of Evidence, Vol. II. App. page *203*.

Sandford, Sir F. R.
Evidence of, 8360–8464. Analysis of Evidence, Vol. I. App. page *122*.

Sandhurst College.
General and special school at, 940.

Sanscrit.
At Oxford University, 4135.
At Edinburgh University, 9276.

Scaping, Mr.
As teacher of navigation, 857–860.

Scherr, Dr.
Instruction of children by, 8149–8155.

Schneider's Schools. See *Creuzot.*

Scholarships.
Estimate for, 7.
Under Science and Art Department, 7, 18, 6486.
Translation of regius chairs into, 127–134.
Objection to State scholarships being taken in State institutions, 250.
At School of Naval Architecture, 1035–1037.
No national scholarships in America, 1435.
For elementary schools, 2100–2103.
At Glasgow University, 2661–2664, 9905.
At Oxford University, 2889–4843, 13,775, 13,811–13,814.
More wanted for science, 3011–3020, 3055, 3088, 3448.
College funds for science scholarships, 3349.
Objection to, for young men, 4335.
At Cambridge University, 4337–5600.
Whitworth scholarships, 6892, 7283, 7285.
At King's College, 6892, 7013, 7068, 7091–7123.
At Owens College, 7287.
Rumney scholarships, 7287.
Hope Chemistry Prize, 9385.
At Edinburgh University, 9385.
Advantage of, to original research, 9515.
None for science at St. Andrew's University, 9644.
At Dublin University, 12,756–12,758.
At Queen's College, Galway, 13,139–13,144, 13,177, 13,196, 13,240.
At Queen's College, Cork, 13,209–13,215, 13,240.
At Queen's College, Belfast, 13,240, 13,256, 13,275–13,279, 13,283.
For Catholics, 13,366.
At Catholic University of Ireland, 13,366, 13,371, 13,396.
See *Fellowships.*

School Fees.
Payment of, by masters, 1833, 1870, 1930.
See *Fees.*

School Inspectors. See *Inspectors of Schools.*

Schoolmasters.
Scientific instruction of, and teaching by, 252–311, 2149–2210, 6120–6165, 8239–8243, 8854–8886.
New science classes for, 2149–2210.
Mechanical habits acquired by, 8239–8243.
Instruction for, in Leeds, Bradford, &c., 8854–8866.
See *Elementary Schoolmasters. Teachers.*

School of Art.
Application of art to industries in, 204.

School of Mathematics and Naval Construction.
Formerly at Portsmouth, 911–918.

School of Mines. See *Royal School of Mines.*

School of Naval Architecture. See *Royal School of Naval Architecture.*

School of Practical Mining.
Proposed for South Wales, 6415.

Schools.
Secondary, 243, 324–336, 623, 1658, 1782, 2163–2165 2238–2245, 6476–6486, 7969–7986, 8224–8231, 8324–8344, 12,201–12,212.
Scientific instruction in, &c., 252–278, 605, 631, 1456, 1541, 2780–3972, 4024–4175, 4217, 4310–4343, 4433–4878, 5109–5256, 5402, 5955, 6104, 6417–6972, 7196–7201, 7515, 7703, 7771–8083, 8387–8392, 8919–10,016, 10,061–12,696, 13,201–13,838.
Graded, in America, 1456, 1541.
Polytechnic, 1584, 1673–1676, 1755, 2330.
In Oldham, 1795.
Free schools, 1825, 1871, 1874, 1930.
Endowed; science teaching in, graduated system for, &c., 2829, 3416, 3578, 3634, 4466, 4635, 4771, 4878, 5958, 5976, 8342.
Typical illustrations for, 2966–2973.
Combination of literature and science in, 2974–2976, 3231, 3741, 4310, 4342.
Connection of Oxford University with, 3013–3015, 3055 3195–3199, 3394–3448, 3699, 3825, 4024–4027, 4064–4068, 4175, 4217, 4846–4878.
Greek and German languages in, 3578, 3719–3736, 3971.
Separate, for science, proposed by Endowed Schools Commission, 3634–3636.
At Rugby, 3697.
In Germany, 3718, 3742–3745, 5210–5219, 10,088–10,091, 10,304.
Bifurcation in, 3723–3725, 5210–5219.
Improving standard of, 4028–4030.
Classificatory subjects in, 4119–4121, 4603.
Connection of, with Cambridge University, 4433–4771, 5225–5256, 5402.
Effect of competitive examinations on, 4531.
Woolwich candidates from, 4605–4609.
Laboratories, &c. in, 4629.
At Rugby, Clifton, Harrow, &c., 4629.
Inadequate time for science in, 4631.
Science school near Cambridge, 5207, 5241–5243.
Advantage of practical and theoretical schools, 5207.
Technical schools, 5210–5276, 6969–6972, 9431, 9548–9551, 9601.
Continental technical schools, 5211.
Natural science exhibition for, 5402.
Demand for science teachers in, 5955–5958.
Want of different grades of, 5955.
Middle-class, 5956, 5974–5976.
Application of, for Department laboratory grant, 6104.
Visits of, to British Museum, 6597–6618, 7771–7773.
As affecting London University, 7866–7879.
Inspection of, 8387–8392, 8919–8921.
As affecting Edinburgh University, 9339, 9502, 9585.
As affecting Glasgow University, 9579–9591.
Scottish, 9579–9612, 9809–9828, 9996–10,016, 12,411–12,514.
Confusion of Departments of Education and of Science and Art in regard to, 9588–9591.
At Glasgow, 9601, 10,005–10,014.
As affecting St. Andrew's University, 9695–9784.
Advantage of local museums to, 9912, 10,150, 10,304–10,307.
As affecting Anderson's University, 9977, 9996–10,016.
Glasgow Secular School, 10,005–10,014.
Collections connected with, in Germany, Denmark, and Sweden, 10,304–10,307.
At Aix-la-Chapelle, Carlsrühe, &c., 10,824–10,845.
Scientific head masters for, 10,848.
Teaching weights and measures in, 11,656, 11,708–11,714.
Meteorological instruction in, 12,411, 12,461, 12,513.
Science teaching in parochial schools, 12,423, 12,460.
Royal Geographical Society's prizes for, 12,605, 12,610–12,619.
Poor youths of special ability in, 12,682.
Aid to, for promoting research, 12,696.
In Ireland, 13,201, 13,453–13,480.
As affecting Catholic University of Ireland, 13,457.
Apparatus for, at South Kensington, 13,833–13,838.
See also *Elementary Schools. Science Schools. Technical Schools.*

Schools' Inquiry Commission.
Endowments to science schools by, &c., 1726, 1734.

Schools of Science.
Receiving aid from the Science and Art Department, Minute of the Lords of the Committee of the Privy Council on Education on the instruction given in the, App. XIX., Vol. I., p. *57*.

Science.
State aid for (see *Grants in aid of Science*).
Theoretical, as allied to practical science, 590–724, 1028–1098, 1343, 1448, 1509, 1581–1777, 3481, 5207, 7254, 7283, 7367, 9171–9294, 9509–9551.
For schools (see *Schools*).
In America, 1403–1541, 1564, 8320–8340.
How to be learned, 1673–1777.
As affecting literature (see *Literature*).
For children (see *Children*).
Objection to " Government science," 1767.
Impediments to, 3586–3648.
Not attractive in universities, 3897–3947.
Cabinet ministers should have knowledge of, 3948–3952.
National laboratories for (see *Laboratories*).
For centres of industry, 5109, 5127–5129, 9157–9177.
Practical and theoretical schools for, side by side, 5207.
In Germany and France, 5215–5223, 10,921–10,924, 13,035–13,101.
Advantage of local museums to, 6643.
Anatomy and zoology, 6852.
Permanent Government officer for (see *Minister for Education and Science*).
Ignorance of public men regarding, 7238.
High value of, as culture and discipline, 7254.
Danger of regard for application of, 7254, 7283.
For artizans, 7394.
As regards England and the continent, 7384–7387, 7403, 9157, 9236, 10,560.
Science council (see *Council of Scientific Advice*).
Connection of departments of scientific teaching, 7895.
Dull students improved by, 7897.
Under Revised Code, 8033–8082, 8295, 8334–8520, 8574, 8623.
Under Education Department, 8067–8077, 8367–8384, 8608–8621, 11,875.
Under Endowed Schools' Commission, 8219–8261.
In the Black Country, 8501–8525.
In Belgium, 8505.
At Newcastle College of Science, 8757–9233.
Appreciation of, by employers, 8795–8804, 9217.
Teaching of, in mechanics' institutes, 8866.
Under Society of Arts, 9001–9016.
Want of instruction in metallurgical science, 9155–9158.
Government and Universities should encourage, 10,847–10,850, 10,922–10,956.
Scientific head masters for schools, 10,848.
In relation to standards of weights, &c., 11,655–11,754.
Questions of, arising in India, 12,565.
As educational training, 12,981.
Want of a State scientific secretary, assistants, and council, 13,035–13,136.
In connection with Civil Service Commission, 13,492.
Parliamentary votes for, for the Middle and Upper Classes in 1867–68, exclusive of the cost of the Queen's Colleges in Ireland, App. II., Vol. I., p. *5*.
See *Grants for Science Purposes*.

Science and Art Department.
Foundation, science classes, examinations, payments, &c., 1–86, 252–801, 1615–2386, 4881–6481, 7122–10,209, 12,462, 13,625, 13,858.
Incorporation of College of Chemistry with, 86.
Directory of, 258–260.
Good done by, 265, 1950, 4882–4884, 9008.
Connection of Education Department with, 354, 1952, 2039, 6462, 6467, 9538.
Exhibitions of, 390–482, 2100–2103.
Cramming for examinations under, 632, 2246, 2254, 6129, 6250.
Increase of candidates under, 1708–1733.
Improved action of, for artizans, 2025–2030, 2034, 2038.
Fault of, in its rules, 2039, 2152–2287, 6302, 8365.
Has given an impetus to science, 2084.
Fees of students under, 2155–6432.
Aid to organizing masters by, 2169
Instruction of teachers in London by, 2174–2177, 8066.
Report to, on Paris Exhibition, 2206.
Ages, &c. of candidates of, 6104.
Assistance for laboratories, &c. by, 6104–6107, 2154.
Payments on results by, 6170.
Inspection by, 6173–6182.
Limitation of subjects under, 6461.
Dr. Hofmann's report to, on chemical laboratories, 7385.

Science and Art Department—*cont.*
Art scholarships and teachers under, 8125, 8134.
Society of Arts' science examinations handed over to, 9002–9016.
Transference to, of Edinburgh University Museum, 10,207–10,289.
Looks to attraction of museums, 10,209.
Imperfectly known in Scotland, 12,462.
Aid given to scientific instruction by, App. I., Vol. I., p. *1*.
Comparison of the fees of students and the payments on results in science schools under the, App. XVIII., Vol. I., p. *56*.
Confidential memorandum with regard to the preparation of the Papers for the Science Examinations, May 1870. Prepared for the use of the examiners, App. III., Vol. I., p. *6*.
Correspondence with the, relating to the First Report of the Royal Commission on Scientific Instruction and the Advancement of Science, and a Memorial addressed to the Department by the Director of the Royal School of Mines, App. III., Vol. II., pp. *2–4*.
Reports from the Professional Examiners under the, App. XVII., Vol. I., pp. *48–56*.
Schools of science receiving aid from the, Minute of the Lords of the Committee of the Privy Council on Education on the instruction given in the, App. XIX., Vol. I., p. *57*.
Science form No. 331, respecting the Science Examinations of the, App., IV., Vol. I., p. *7*.
Teachers of Science Classes in connexion with the, in 1869–70, analysis of, App. XII., Vol. I., p. *41*.

Science and Art (Ireland) Commission.
No action taken upon Report of, 13,858.

Science Classes.
Increase of, 2.
Examinations of, and payments to, 2.
Numbers of, 172.
Evening science classes, 176–200, 2210.
Advocacy of, by Adam Smith, 200.
Artizans in, 1953–1958, 2005, 2228–2230, 8994.
Instituted by trades' unions, 1956–1966.
At Creuzot, 1869.
In Plymouth, 2087.
Under East Lancashire Union, 2136–2151.
Schoolmasters' classes, 2149–2210, 5905.
In North-east Lancashire, 2287.
For teachers, 4895.
Apparatus for, 5921.
Under Science and Art Department (see *Science and Art Department*).
In Yorkshire, 6122, 6154–6165, 6267, 8868–8875.
Cramming for (see *Cramming*).
Inspection of, 6173–6182, 8360.
In Bradford, 6237–6302.
Effect of, on industrial occupations, 6303.
In Bristol, 6337, 6340.
Pharmaceutists at, 6337, 6340.
Fees in, 6432.
Local efforts respecting, 6434–6440.
Rival classes, 6438.
Advanced and elementary classes, 6457.
At Borough Road and Stockwell Colleges, 8192–8204.
At Huddersfield Mechanics' Institute, 8842, 8876–8882.
Half-time school children in, 8967–8971.
Wanted for agricultural chemistry, 8998.
See *Science Schools*.
Number of Students attending, during the Session 1869–70, App. IX., Vol. I., pp. *33–38*.

Science Colleges.
Establishment of, 2925, 8266–8283, 8937–8958.
Wanted for Leeds, Newcastle, Manchester, &c., 2925.

Science Directory. See *Directory* (*Science and Art*).

Science Examination Papers. See *Examination Papers*.

Science Examinations.
Science and Art Department, form No. 331., App. IV., Vol. I., p. *7*.
In May 1870, confidential memorandum with regard to the preparation of the Papers for the, App. III., Vol. I., p. *6*.
See *Examinations in Science, &c.*

Science Examiners. See *Examiners in Science, &c.*

Science Form.
Form No. 331, respecting the Science Examinations of the Science and Art Department, App. IV., Vol. I., p. 7.

SCIENCE INSPECTORS.
Under Science and Art Department, 7, 33–37, 2246–2254, 5973.
See *Inspection of Schools.* *Science Classes.*

SCIENCE, LITERATURE, &c.
Appropriations in aid of, made by the United States Congress in 1869–70 for the ensuing year, App. I., Vol. II., p. *1*.

SCIENCE SCHOLARSHIPS. See *Scholarships.*

SCIENCE SCHOOLS.
Establishment of, &c., 2–18, 81–353, 829–831, 1173–1338, 1802–2133, 2791–2820, 3064–3749, 6005–6008.
In Oldham, 1802, 1823, 1860, 1904, 1927.
Want better supervision, 1817–1822, 1833, 1901.
Advantage of, to masters and men, 1824.
At Aix-la-Chapelle, 1836.
Industrial applications of science not suited for, 1173.
School of Mines a good school of science, 1197, 1198.
On the continent, 1225.
Want of, for artisans, &c., 1725–1728, 2802.
Application of endowments to, 1734.
In Plymouth, 2101, 2133.
At Berlin, Leipzig, Bonn, &c., 7384–7406.
Denominational bias to have no place in, 8098.
Under the Science and Art Department, form used by the Inspector of, App. X., Vol. I., pp. *38, 39*.
See *Royal School of Mines, Science Classes, &c.*

SCIENCE STUDENTS.
Under Science and Art Department, 18–47, 256–350, 569–687, 2145–2276, 4882–4931, 6084–6475.
Ages of, 350, 6460, 6471–6475.
Value of, in manufactories, 1173.
Sent here from the continent formerly, 1227.
In continental schools, 7384–7389.
In Germany, 7390.
See *Owens College, Royal School of Mines, Students, &c.*

SCIENCE TEACHERS.
Under Science and Art Department, 2–201, 265–785, 949–952, 1804–2266, 4888–8958.
Brought to London for instruction, 13, 778–785, 5688–5743, 8028.
Cramming adopted by (see *Cramming*).
Difficulties of, 1174, 2039.
Greater efficiency of, desirable, 1809.
Low remuneration of, 5800–5802.
At College of Chemistry, 5688–5743, 5816–5847.
Classes for, in Manchester, Leeds, &c., 5905.
Training college for, required, 5954–6219.
Want of confidence in Department by, 6202.
Teaching method to, 6211–6230, 8005.
Trained at University College, 7194.
In Germany, 7384–7406.
Should have leisure for research, 7421–7428.
Demand for, in schools, 7795.
Teachers of social science, 8731–8754.
In Birkbeck schools, 8739, 8741, 8756.
Testing qualifications of, 9037–9041.
Edinburgh University might instruct, 9339, 9502.
In Scotland, 9593–9608.
University degree as qualification for, 9597.
Saint Andrew's University might instruct, 9695–9701.
Anderson's University might instruct, 10,048.
Catholic University of Ireland might instruct, 13,457.

SCIENCE TRAINING COLLEGE. See *Metropolitan College of Science (proposed).*

SCIENTIFIC ADVICE FOR GOVERNMENT. See *Council of Scientific Advice.*

SCIENTIFIC INSTITUTIONS.
Experimental with practical teaching for, 1545–1553.
National, should be under one council, 12,046, 12,138–12,184, 12,961–13,032.

SCIENTIFIC INSTRUCTION.
For children (see *Children*).
Dr. Arnott's toys for, 322.
In French and German schools, 1173, 1268, 5866.
Duty of Government respecting, 1175, 1189.
Backward state of, 5866.
(Advanced) aid given to, under the Science and Art Department, App. I., Vol. I., p. *2*.
(Elementary) aid given to, under the Science and Art Department, App. I., Vol. I., p. *1*.
And the Advancement of Science, aid given to, by the University of London, and University College, London, App. XIII., Vol. I., pp. *41–43*.

SCIENTIFIC INSTRUCTION—*cont.*
Memorandum on the Progress of, in Yorkshire, by Henry H. Sales, App. XI., Vol. I., pp. *39–41*.
In Germany: communication from Professor Hofmann respecting, App. XVII., Vol. II., pp. *71, 72*.
See *Science, Science Classes, &c., &c.*

SCIENTIFIC INSTRUMENTS.
Education of makers of, 13,575.
In Meteorological Office, 13,891–14,478, 14,515.
For ships, 13,897–14,478, 14,515.
Supply of, by physical observatories, 14,326.
Galton's pantagraph, Amsler's planimeter, and De la Rue's anemometers with bells, 14,427–14,430, 14,471.
For meteorology, improved through Mr. Glaisher, 14,500, 14,517.
Position of meteorological instruments, 14,515.

SCIENTIFIC PUBLICATIONS.
Of Smithsonian Institution, 1407–1568.
Of American Government, 1470–1544.
Elementary science books in America, 1541, 1564.
Bad system of publishing scientific notices, 3205–3209.
In Germany, 5215–5223.
Government should publish results from surveys, &c., 5222, 10,939, 10,957–10,959, 11,119, 11,790–11,794.
Contributions of Government Grant Committee for, 11,172–11,178.
Royal Society Catalogue of Scientific Papers, 11,183–11,197.
Of Meteorological Committee, 11,354–11,445, 14,129, 14,139, 14,212–14,480.
Government aid to scientific societies for, 11,775–11,778, 13,546.
Printing of astronomical observations at Glasgow, 12,284.
Of Scottish Meteorological Society, 12,395–12,398.
Of Scottish scientific societies, 12,422–12,516.
Of Royal Geographical Society, 12,609.
State council should publish resources available for science, 12,681, 12,687.
Of Dublin University, 12,767–12,774, 12,782.
Of Royal Irish Academy, 12,792–12,804.
"The Atlantis," at Catholic University of Ireland, 13,439–13,506.
Of Meteorological Society, 14,155–14,157.
"Fragmentary Papers" of Meteorological Office, 14,419–14,422.
"Atlas des Mouvements généraux de l'Atmosphère," 14,454.

SCIENTIFIC SOCIETIES.
Exchanges between, and Smithsonian Institution, 1407, 1426.
In America, 1470–1474.
Voluntary assistance to, 3142.
Ignorance of, respecting Government Grant Committee, 3155, 3163.
Nominees from, as boards of visitors, 6774.
Publications of, 6838–6842, 7490–7566.
Promotion of meteorology through, 10,046, 14,052, 14,326, 14,341.
In Germany and France, 10,086, 11,833–11,844.
At Belfast, 10,306–10,308, 12,318.
Importance of, 10,443–10,476, 11,037, 12,127–12,134.
Accommodation for, at Burlington House, 10,443–10,476, 11,037, 11,119, 12,598–12,600.
Connexion between, and Government, 10,541, 10,671–10,673, 11,771–11,832, 12,226–12,236.
Philosophical Society of Manchester, 10,596–10,673.
Absence of private societies on the continent, 11,037.
English and German chemical societies, 11,053–11,061.
Private associations and science, 11,354.
A minister for science might apply to, 11,539.
State aid for, 11,771–11,832, 12,226–12,236, 12,422–12,516, 13,510–14,523.
Council of science might organize, 11,893, 11,894.
Nominees of, might be members of a State science council, 12,090.
In Scotland, 12,422–12,516.
Royal Dublin Society, 12,819.
Valuable publications of, 14,155–14,157.

SCLATER, P. L., ESQ., PH.D.
Evidence of, 6769–6843, 12,042–12,137. Analyses of Evidence, Vol. II. App. page *135* and page *201*.

SCOTLAND.
Geology well taught in, 686.
Geological and Ordnance Surveys in, 754.
Science teaching in schools of, 1656–1658, 2686.
Secondary schools, 1658, 12,201–12,212.
Room in, for fresh chairs, but not a fifth university, 1772.

SCOTLAND—*cont.*
Promotion of science in, 9569–9614, 12,420–12,547.
Contributions for science in, 2688–2692, 2869.
Meteorological Office observatories in, 11,243.
Scottish Meteorological Society, 11,243–11,256.
Science grants for, 12,223, 12,224.
Might have a board for science, in communication with a London council, 12,446–12,459.
Wants means to pass poor scholars into higher schools, 12,460–12,465.
Public and Government aid to science in, 12,539–12,546.
Grants to Ireland for science greater than to Scotland, 12,547.
Meteorological establishments in, 13,932, 14,377.
See *Edinburgh University, Glasgow University, &c.*

SCOTT, VERY REV. R., D.D.
Evidence of, 4819–4879. Analysis of Evidence, Vol. II. App. page *105*.

SCOTT, R. H., ESQ., M.A.
Evidence of, 13,861–14,020, 14,381–14,496. Analysis of Evidence, Vol. III. page *9*.
Communication from, containing Supplementary Evidence respecting the Meteorological Office, App. III., Vol. III., pp. *5, 6*.

SCOTTISH METEOROLOGICAL SOCIETY.
Its stations, apparatus, journal, &c., 12,357–12,641, 13,932–14,380.
Communication from the, App. XIII., Vol. II., pages *64–67*.

SCOTTISH UNIVERSITY COMMISSION.
Reforms by, 9265–9277, 9310.

SCOTTISH UNIVERSITIES.
Correspondence between Her Majesty's Commissioners and the Heads of the, App. V., Vol. II., pages *5–16*.

SCOURING.
Instruction in chemistry of, 8889–8891.

SEAMEN.
Examinations for, 865–875.

SECONDARY SCHOOLS.
Foundation of, science teaching in, &c., 243, 324–336, 623, 1658, 1782, 2163–2165, 2238–2245, 6476–6486, 7969–7986, 8224–8231, 8324–8344, 12,201–12,212.
In Scotland, 1658, 12,201–12,212.
In East Lancashire, 2163–2165, 2238–2245.
In America, 8325.
See *Mining Schools. Schools. Science Schools.*

SEDLEIAN READERSHIP (OXFORD).
Has too many subjects, 3470–3480.

SELLA, SIGNOR.
On British Geological Survey maps, 757.

SELWYN, MR.
Director of Geological Survey of Canada, 757.

"SEMINARIA."
In Germany, 7389.

SEWAGE.
Want of experiments relating to, 11,574–11,577.

SHEEPSHANKS, MR.
His bequest of pictures, 9073, 9084.

SHEFFIELD.
Private trade school at, 5949.

"SHEFFIELD INDEPENDENT."
On trades' unions' schools, 1957.

SHIELDS, MR.
Economic science taught by, 7157.

SHIP-BUILDING.
Instruction in principles of, 4395, 5191.
Development of science relating to, 12,706–12,720.

SHORE, MR. THOMAS WILLIAM.
Evidence of, 2136–2287. Analysis of Evidence, Vol. I. App. page *94*.

SIDNEY COLLEGE (CAMBRIDGE).
Promotion of science at, 4326–4436, 5081.

SIDNEY SUSSEX COLLEGE (CAMBRIDGE).
Promotion of science at, 5193–5649.

SIEMENS, C. W., ESQ., D.C.L.
Evidence of, 11,755–11,873. Analysis of Evidence, Vol. II. App. page *199*.

SLADE SCHOOL OF FINE ARTS.
At University College, 7142.

SMITH, ADAM.
Advocacy of science classes by, 200.

SMITH, DR.
Prizes of, at Cambridge University, 4247, 4250.

SMITH, HENRY J. S., ESQ., M.A.
Evidence of, 3463–3573. Analysis of Evidence, Vol. II. App. page *87*.

SMITHSONIAN INSTITUTION (WASHINGTON).
Its foundation, aid to science, museum, publications, &c., 1403, 1573.
Board of regents of, contrasted with Government Grant Committee, 1573.

SMYTH, PROFESSOR PIAZZI.
Statement by, respecting the Royal Observatory, Edinburgh, App. V., Vol. II., pages *14–16*.

SMYTH, WARINGTON W., ESQ., M.A.
Evidence of, 2288–2467, 7440–7452. Analysis of Evidence, Vol. I. App. page *95*.
Lectures by, 365, 7597.

SOCIAL SCIENCE.
In Birkbeck schools, 8730–8756.
Lectures on, at South Kensington, &c., 8742.
As a Department subject, 8743–8749, 8755.
Should be blended with general science, 8756.

SOCIETY OF ARTS.
On technical training, 1274–1276, 7283.
Encouragement of science by, 9001.
Union of mechanics' institutes under, 9002, 9017–9027 9045–9047.
Science examinations of, 9002–9052.
Originated system carried out by Science and Art Department, 9009–9016.
Deputation from, on national museums, Vol. II. page 365.

SOUTH AMERICA.
Copper ore of, and Cornish mining, 2345–2351.

SOUTH KENSINGTON.
As a locality for a college of science, 49, 54, 5703, 5752, 6108–6111.
Accommodation at, 56–17, 788–791, 946–948, 5740, 5733–5753, 7441–7447, 5986–5992.
Proposed removal of School of Mines to, 403–422, 2469–2488, 7440.
Laboratories at, 788–791, 946–948, 5704, 5733–5753.
Metropolitan Railway takes away objection to, 5752.
New natural history museum at, 6603–7211, 7475–7776, 11,565.
Proposed removal of museum of Royal College of Surgeons to, 6854, 6860–6868.
As a locality for natural history collections, 7483, 7520, 7755–7759, 7776.
Training colleges could use a science school at, 8053.
Instruction of science teachers at, 8941–8956.
Patent Museum at, 10,595, 11,565.
See *Science and Art Department.*

SOUTH KENSINGTON MUSEUM.
Might circulate science specimens, 2970.
Proposed training school at, 6046.
As affecting British Museum and Kew, 6663, 7205, 7211, 12,987, 13,005–13,025.
Lectures on social science at, 8742, 8755.
Government, cost of, &c., 9055–9072, 9092–9097, 9104.
Under Lord President, 9063–9066, 9091.
Circulation of specimens by, 9076–9084, 9114–9118, 9148.
Pictures lent to, 9086.
Commission of noblemen, &c. for, 9090–9097.
Professional advisers consulted at, 9092–9097, 9104.
Attraction of, 9113.
Visitors to, 9145–9147.
Its science collections, &c., 13,833–13,857.

SPEAKER OF THE HOUSE OF COMMONS.
Appointing trustee of British Museum, 6491, 6562–6566, 7456–7663.

SPECTROSCOPY.
Study of, on the continent, 10,561, 10,563.

SPECTRUM ANALYSIS.
Provision requested of Admiralty for, 11,599.
See *Lockyer, J. Norman, Esq.*

SPOTTISWOODE, W., ESQ., LL.D.
- Evidence of, 11,970–12,041. Analysis of Evidence, Vol. II. App. page *201*.

STAFFORDSHIRE.
- Waste of coal in, through ignorance of science, 482, 2391, 2452, 2600–2602.
- Desire for geological maps in, 754.
- Mining instruction wanted in, 2388–2453.
- Assessment in, for science, desirable, 2452.
- Improved scientific education in, 2543.
- Mining in, compared with Belgium, 8505.

STANDARD WEIGHTS AND MEASURES.
- Supervision of, by Board of Trade, 12,622–12,631.

STANDARDS.
- Relation of, to science, 11,655–11,754.
- Royal Commission on, 11,656, 11,668.
- Apathy of Government in regard to, 11,656, 11,685.
- Gas-measuring standards, 11,656, 11,718.
- Burned with Houses of Parliament, 11,668.
- Copies of national standards, 11,669.
- Scientific re-verification of, 11,671.
- Uniform system for, 11,707–11,715.
  - See *Weights and Measures*.

STANDARDS' DEPARTMENT.
- Its government, duties, appointments, &c., 10,381–10,416, 10,441, 10,489, 10,492, 11,354, 11,502, 11,655–11,790.

STATE AID TO SCIENCE. See *Grants in aid of Science*.

STATIONERS' COMPANY.
- Payment to St. Andrew's University by, 9655.

STATISTICS.
- Relating to drawing, 6080–6082.
- Government and a scientific council should undertake, 11,485, 11,486.

STEINER, MR.
- Advantage of knowledge of chemistry to, 823.

STEWART, PROFESSOR BALFOUR, F.R.S.
- Evidence of, 11,354–11,534, 14,021–14,114. Analyses of Evidence, Vol. II. App. page *197*, and Vol. III. App. page *10*.
- On physical laboratories, 7366, 7418.

STOCKWELL FEMALE TRAINING COLLEGE.
- Science at, 8169–8172.

STOKES, PROFESSOR, F.R.S.
- Lectures on physical optics by, 4284.
- Light studied under, 4324.

STRACHEY, MAJOR-GENERAL, R.E.
- Evidence of, 11,874–11,917, 14,211–14,301. Analyses of Evidence, Vol. II. App. page *200*, and Vol. III. App. page *44*.

STRANGE, LIEUT.-COL. A., F.R.S.
- Evidence of, 10,311–10,476, 10,963–11,052, and Vol. II. page 368. Analysis of Evidence, Vol. II. App. page *190*.
- Communications from, respecting the proposed establishment of a physical observatory, App. VII., Vol. II., pages *27–31*.

STUDENTS.
- Under Science and Art Department, 1–86, 252–801, 1615–2386, 4881–6481, 7122–10,209, 12,462, 13,625, 13,858.
- At Royal School of Naval Architecture, 13, 227, 236, 876–2083, 5735–6047.
- At Royal School of Mines, 18, 283–742, 1108–1113, 2333–2462, 5839, 7742–7447.
- Foreign, 993.
- Medical, 1739–1750, 3580, 5099, 13,472–13,479.
- At Glasgow University, 2656–2866, 9506–9608, 9795–9859.
- Age of 2781–2793, 3056–3097, 3639, 8233, 9242, 13,480.
- Entering universities from schools, 2940, 3557.
- At Oxford University, 2999–4217, 4820–4878 13,667–13,812.
- At Cambridge University, 4231–4806, 4959–5598
- Modified instruction for professional students, 4342.
- Woolwich candidates, 4604–4609.
- Effect of competitive examinations on, 5452, 10,741, 10,758, 11,760.
- At British Museum, 6498–6597, 6779, 6831, 7463–7466, 7771, 10,195–10,201.
- At Kew Gardens, 6673.
- At College of Surgeons, 6853–6868.
- At King's College, 6879–7700.
- At University College, 7132–7192, 7780–7853.

STUDENTS—*cont.*
- At London University, 7865–7897.
- At Saint Mark's College, 7903–8013.
- Under Revised Code, 7918.
- Education Department examinations for, 7950–7963.
- In training colleges, 7975–8250.
- Living in lodgings, 7997–8007, 8051, 8232–8250.
- South Kensington as a locality for, 8053.
- Science exhibitions for, 8116, 8124.
- At Homerton College, 8129.
- At Newcastle College of Science, 8764–9233.
- Under Society of Arts, 9035–9052.
- Objection to college workshops for, 9186–9191, 9224.
- At Elswick, 9233–9235.
- Manufactory with college instruction for, 9237–9246.
- At Edinburgh University, 9264–9494.
- From India, Japan, Spain, &c., 9552.
- At St. Andrew's University, 9616–9788.
- At Anderson's University, 9947–10,070.
- In Germany, 10,099, 10,922.
- Poor, in Scotland, 12,460–12,465.
- State aid to, for continuing their studies, 12,682.
- At Dublin University, 12,730–12,903.
- At Queen's College, Galway, 13,138–13,198.
- Engineering, 13,138–13,198.
- At Cooper's Hill College, 13,158–13,164.
- Difficulties of Irish, 13,158–13,164, 13,201–13,495.
- At Queen's College, Cork, 13,202–13,247.
- At Queen's College, Belfast, 13,254–13,330.
- At Catholic University of Ireland, 13,362–13,495.
- Scholarships for Catholics in Ireland, 13,366.
- In Irish secondary schools, 13,480.
- Want of a career in science for, 13,492–13,495.

STUDENTS' DIARIES. See *Diaries*.

STUDENTS (NUMBERS OF).
- Attending science classes during the session 1869–70, App. IX., Vol. I., pages *33–38*.

STUDENTSHIPS. See *Scholarships*.

STUTTGART.
- Polytechnic school at, 10,835.

SULLIVAN, W. K., ESQ., PH.D.
- Evidence of, 13,424–13,480. Analysis of Evidence, Vol. II. App. page *186*.

SUMMER.
- Teaching botany in, 4897, 4930.

SUN.
- Photographic observations of, &c., 14,023, 14,152.
- Special observatory for solar observations, 14,024–14,114.
  - See *Lockyer, J. Norman, Esq.*

SUNDAY.
- Proposed opening of British Museum on, 6547–6551, 7471–7509.
- Museums in Germany open on, 7508.
- Conservatoire des Arts et Métiers, Paris, open on, 9099.
- No work by Meteorological Office on, 14,469.

SUPERANNUATION.
- For professors, 2759, 3030, 3347–3393, 3460, 3522–3526, 3809, 5554, 7132, 7681–7685.
- For Oxford professors, 3030, 3460, 3522–3526.
- Connexion of fellowships with chairs for, 3347, 3392.
- For Cambridge professors, 5554.
- Masterships of colleges available for, 5554.
- For University College professors, 7132.
- For King's College professors, 7681–7685.
- For members of a State scientific council, 11,002, 11,632, 12,993.
- Civil Service List should be augmented for science, 11,119, 11,134, 11,179–11,182.
- Government Grant Committee can award, 11,172.
- Societies should recommend, for scientific services, 11,831.
- For State-appointed investigators, 13,569.

SURGERY.
- Lectures, &c. on Edinburgh University, 9264, 9281, 9284.

SURVEY EXPEDITIONS.
- Collections of objects obtained by, 6569–7575.
- In Germany, 10,104–10,107.
- As affecting British Museum, 10,144–10,147, 11,611.
- More desirable, 10,639–10,645.
- Deep-sea dredgings and circumnavigation expedition, 10,930–10,935, 11,823–11,240.
- Disposal of specimens from, by Admiralty, 11,541–11,544, 11,600–11,611.

SURVEY EXPEDITIONS—*cont.*
- Magellan Straits' expedition, 11,541–11,544.
- Specimens from, sent to Jermyn Street Institution, 11,541–11,544.
- Funds for, 11,595.
- For hydrographical purposes, 11,638–11,653.
- Where usually conducted, 11,649–11,653.
- Recommendations of Royal Society respecting, 11,238–11,240.
- Trained naturalists for, 12,097–12,135.
- Promotion of, &c. by Royal Geographical Society, 12,549–12,551, 12,608, 13,646.
- Nassau expedition, 13,348–13,356.

SURVEYING.
- Class for, wanted at School of Mines, 2420.

SWAN, W., ESQ., LL.D.
- Evidence of, 9705–9758. Analysis of Evidence, Vol. II. App. page *179*.

SWANSEA.
- As a locality for a mining school, 2510.

SWEDEN.
- Science in, 9158.
- Natural history collections in schools of, 10,304.
- Co-operation with, for meteorological purposes, 14,147.

SWITZERLAND.
- Laboratory, education, &c. at Zurich, 47, 7384, 7389, 8149–8155.
- Practical teaching in, 320.
- Scientific knowledge of watchmakers in, 2010.
- Technical education in, 2010.
- Compulsory education in, 2015.
- Primary schools in, 8145–8155.

SYDNEY UNIVERSITY.
- Professors in, 5683.

SYLLABUS OF THE EDUCATION DEPARTMENT.
- As affecting scientific instruction, &c., 7907–8140.
  - See *Revised Code*.

SYMONS, J. G., ESQ.
- On British rainfall, 3113–3116.

T.

TAIT, P. G., ESQ.
- Evidence of, 9397–9462. Analysis of Evidence, Vol. II. App. page *166*.

TASMANIA.
- Director of Geological Survey of, 757.

TEACHERS.
- Objection of, to withdrawal of augmentation grant, 7910.
- Great demand for, 7960–8019.
- Third year's special course for, 7964–7968, 8015–8018.
- Incompetency of, in private adventure schools, 7974.
- Position of, before and after Revised Code, 8011–8013, 8213–8219.
- Universities might train teachers, 8269–8276.
- Failure of superior scholars as, 8277–8279.
- In America, 1541, 8299.
  - See *Drawing Teachers. Elementary Schoolmasters. Science Teachers.*

TEACHERS OF ELEMENTARY SCHOOLS.
- The Worcester, Lichfield, and Hereford Training College for: extracts om the reports of the Committee of Governors of the, for 1867 and 1868, App. XVI., Vol. I., pages *47*, *48*.

TEACHERS OF SCIENCE CLASSES.
- In connexion with the Science and Art Department, in 1869–70, Analysis of, App. XII., Vol. I., page *41*.

TECHNICAL EDUCATION.
- Under Society of Arts, 1274–1276, 7283.
- Want of, for telegraphy, &c., 1585, 1603.
- As allied to scientific, 1666–1682, 7283, 9509, 9548–9551.
- In workshops, 1678–1783, 2793–2859, 3373, 3425, 9186–9191, 9429–9431, 9511, 9532–9535, 9550, 9608.
- For engineers' apprentices, &c., 1687–1692, 2793–2859, 3373.
- In universities, 1743–1746, 1773, 3042.
- For schools, 1773, 1985, 2793–2859.
- French Report on system of, in Germany, 1945.
- Provision for, in England, 1946–1949.
- Correspondence on, with Professor Jenkin, 1955.
- "Sheffield Independent" on trades' unions' schools, 1957.

TECHNICAL EDUCATION—*cont.*
- Lord Lichfield's committee for promoting, 1958.
- On the continent, 1969–1974.
- Duty of employers respecting, 1992.
- Under Science and Art Department, 2030, 2352–2354.
- In Prussian mining schools, 2329.
- Confining School of Mines to, 2440–2445.
- At Oxford University, 2950, 3269, 3482, 3785.
- At Cambridge University, 4424–4426, 4496, 4499, 4678–4689.
- At King's College, London, 6996.
- Definition of "technical training," 7283.
- In Halifax, Leeds, &c., 8889–8995.
- Opinion of manufacturers regarding, 8898.
- Artizans at classes for, 8901, 8994.
- At Edinburgh University, 9428–9431.
- Should embrace drawing, 9510.
- At Glasgow University, 9511–9545, 9802–9808.
- Practice combined with science in, 9548–9551.
- Advantage of constructors' workshops for, 9550.
- At Glasgow, 9601, 9612.
- At Anderson's University, 9985–9987, 10,031.

TECHNICAL SCHOOLS.
- Combination of, with normal schools, 334–336.
- Objections to, 1292–1361.
- Assaying taught in, 1297.
- Government aid to, 1338, 1376, 2300.
- Failure of agricultural colleges as, 1360.
- Wanted for mining and mineralogy, 2299.
- At Glasgow, Cornwall, Bristol, Newcastle, &c., 2301, 2306, 9601, 9612.
- Difficulty of separating, from primary schools, 2305.
- Desirability of having, 4343, 9548–9565, 10,027.
- Actual work should not be taught in, 10,027.

TELEGRAPH DEPARTMENT OF INDIA. See *Indian Telegraph Department.*

TELEGRAPHY.
- Necessity for teaching, 1585–1612, 1696.
- Institution of lectures on, 1591–1593.
- Students of, 1604–1612, 6888, 7168, 7794, 7842, 10,683.
- Inefficiency of officers for, 1696.
- Must be learned in workshop and office, 2858.
- Government might aid technical schools for, 5211.
- At King's College, 6888.
- At University College, 7168, 7793, 7842.
- As applied physics, 7793.
- At Edinburgh University, 9429.
- Importance of physical laboratories for, 10,683.
- Want of Government institution for, 11,790, 11,871.
- At Meteorological Office, 13,917–14,495.
- In United States, 14,444.
- Foreign systems of, 14,475.

TEMPLE, DR.
- Pupils of, at a matriculation examination, 4029.

TEST, EDUCATIONAL.
- For science teachers, 9037–9041.
- For Society of Arts' candidates, 9035–9052.

TEXT-BOOKS.
- In America, 1541, 1564, 8334–8340.
- Sir John Herschel's, 3147.
- Professor Huxley's "Physiology," 6264–6266.
- Recommended in Science and Art Directory, 6249.
- Evil of preparing solely from, 7865–7869.
- Dr. Brewer's "Knowledge of Common Things," 8334–8337.
- Of social science, 8756.
- For geography, 12,613–12,616.
- Manual contemplated by Royal Geographical Society 12,613–12,616.
- At Catholic University of Ireland, 13,491.

THEOLOGY. See *Religion.*

THEORETICAL INSTRUCTION.
- As allied to practical, 590–724, 1028–1098, 1343, 1448, 1509, 1581–1777, 3481, 7254, 7283, 7367, 9171–9294, 9509–9551.
- Want of, in naval architecture, 877, 925–928, 1028.
- Small demand for, 901.
- Little imparted in private establishments, 1093–1098.
- On the continent, 1581–1602.
- As a stepping-stone to practice, 1604–1612, 1851–1853.

"THE TIMES."
- Letter to, on the natural history collections, 6597.
- Remarks on a letter in, 7440.

THOMPSON, REV. W. H., D.D.
- Evidence of, 4994–5029. Analysis of Evidence, Vol. II. App. page *119*.

THOMSON, PROFESSOR JAMES.
  On engineering department of Queen's College, Belfast, 13,266.

THOMSON, ALLEN, ESQ., M.D.
  Evidence of, 9791–9933. Analysis of Evidence, Vol. II. App. page *174*.

THOMSON, C. WYVILLE, ESQ., LL.D.
  Evidence of, 10,202–10,310. Analysis of Evidence, Vol. II. App. page *143*.

THOMSON, THOMAS, ESQ., M.D.
  Evidence of, 4880–4945; 7239–7249. Analysis of Evidence, Vol. I. App. page *103*, and Vol. II. page *138*.

THOMSON, SIR WILLIAM, LL.D.
  Evidence of, 2652–2873; 10,674–10,777. Analysis of Evidence, Vol. II. App. pages *169*, *193*.

TIDAL OBSERVATIONS.
  Memorial of the British Association for the Advancement of Science, to the Lords of the Treasury, with regard to, App. IX., Vol. II., p. *32*.

TIDES.
  Government should undertake secular observations of, 10,715–10,724.

"TIMES." See "*The Times*."

TOWER OF LONDON.
  Its collections, 9055.

TOWNSEND, EDWARD, ESQ., M.A.
  Evidence of, 13,138–13,169. Analysis of Evidence, Vol. II. App. page *183*.

TOYS, SCIENTIFIC.
  Dr. Arnott's suggestion respecting, 322.

TRADE SCHOOLS.
  Creation and success of, 2, 1955–1958.
  Employers should establish, 1946–1949.
  Professor Jenkin on, 1955–1958.
  In Switzerland, 2010.
  Difficulty of finding teachers for, 2019.
  Mining school attached to, at Bristol, 2306.
    See *Bristol Trade School*.

TRADES.
  As regards science teaching, 333.
  Followed by Bristol Trade School students, 6338.

TRAINING COLLEGE FOR TEACHERS OF ELEMENTARY SCHOOLS.
  The Worcester, Lichfield, and Hereford: extracts from the reports for 1867 and 1868 of the Committee of Governors of the, App. XVI., Vol. I., pages *47*, *48*.

TRAINING COLLEGES.
  Scientific instruction in, 327, 628, 949–952, 2211–2227, 5939, 6003–8754.
  For teachers, 2225, 5939, 6003, 8015–8024, 8131–8228, 8267–8348.
  Are denominational or semi-denominational, 2227.
  Number of, 6003.
  Foundation of, in populous centres, 6207.
  Instruction in method in, 6211–6213, 6228–6230,
  Laboratories in, 6221.
  Students and curricula of, 6223–6227, 8007,
  At Chester, 7979.
  At Chichester, 7979.
  At Highbury, 7979.
  At York, 7979.
  Examination papers in, 7950–7963.
  Third year's special course for, 7964–7968, 8222, 8232–8245.
  As affected by a school of science at South Kensington, 8053.
  Introduction of more science in, 8073–8077, 8351.
  Science exhibitions in, desirable, 8116, 8124.
  Educating science teachers in, 8131, 8132, 8224–8228.
  Cost of education in, 8230, 8280.
  Moral success attained in, 8234–8237.
  Discipline of, 8236.
  Encouragement to science in, 8284, 8286.
  Insufficient provision for teachers at, 8348.
  Kneller Hall Training College, 8350.
  Under Revised Code, 8355–8357.
  Scientific inspection, laboratory, grants, &c. for, 8478–8508.
  Science should be in syllabus of, 8721.
  Social science in, 8751–8756.
    See *Borough Road Training College*, *Metropolitan College of Science* (*proposed*), *&c.*

TRAVELLING EXPENSES.
  Of inspectors for science, &c., 13.

TREDEGAR.
  Mining school at Merthyr would accommodate, 2564, 2568.

TRINIDAD.
  Director of Geological Survey of, 757.

TRINITY COLLEGE (CAMBRIDGE).
  Promotion of science at, 4089–5588, 7900.

TRINITY HALL (CAMBRIDGE).
  Taxation, lectures, &c. at, 5109, 5198.

TROTTER, REV. COUTTS, M.A.
  Evidence of, 5030–5101. Analysis of Evidence, Vol. II. App. page *120*.

TRURO.
  Technical school at, 2301.

TRUSTEES OF THE BRITISH MUSEUM. See *British Museum*.

TULLOCH, REV. J., D.D.
  Evidence of, 9615–9704. Analysis of Evidence, Vol. II. App. page *177*.

TURNER, W., ESQ., M.B.
  Evidence of, 9262–9340. Analysis of Evidence, Vol. II. App. page *164*.

TUTORIAL INSTRUCTION.
  At Edinburgh, Dublin, &c., 9343, 9400, 12,730–12,734.

U.

UNITED STATES. See *America*.

UNITED STATES CONGRESS.
  Appropriations in aid of science, literature, &c., made by the, in 1869–70, for the ensuing year, App. I., Vol. II., page *1*.

UNIVERSITIES.
  In Scotland, 686, 9516–9519, 9713, 9858–9882, 12,443, 13,055, 13,094–13,101, 13,620.
  Aid to science wanted in, 687, 2932–2935, 4106, 5109, 7881, 9432–10,956.
  Mining instruction in, 710–712.
  No professor of mining in, 740.
  Technical instruction in, 1743–1746, 3042.
  Central administration for, 2932–2935.
  Entering, from public schools, 2940.
  Objects of, 3575–3586, 3606, 9458.
  Difficulties of scientific education at, 3577.
  Greek in, 3578, 3726–3730.
  Competition of medical schools, &c. with, 3578–3581.
  Higher education in, 3582, 3626.
  Libraries and scientific collections for, 3588, 3649.
  Eminent foreigners might be appointed in, 3606.
  Celibacy restriction in, 5043–5049.
  Might instruct teachers, artizans, &c., 5129, 8269–8276, 9432–9434, 9598.
  Influence of schools on, 5146.
  Honours gained in, by King's College men, 7058.
  For purely scientific students, 7114–7116.
  British Museum appointments do not attract men from, 7515, 7518, 7894.
  Fair distribution of rewards of, 7881–7892.
  Want of teaching power of university men, 8277–8279.
  Should offer fellowships, &c. for research, 9435, 9515, 10,532–10,537, 10,742, 10,767–10,777, 10,922–10,929, 10,954–10,956.
  Honorary degrees only should be conferred by, 9458.
  Should impart scientific knowledge, not practical skill, 9512.
  Advantage of vacations in, 9515–9518.
  Enough in Scotland, 9784.
  Advantage of assistants in, &c., 9826, 9850–9856.
  Professors of, should contribute to science, &c., 9845, 9850–9856.
  Museums, &c. in, 10,083–10,114, 10,097.
  On the continent, 10,564, 13,055, 13,094–13,101.
  Evils of competitive examinations of, 10,741, 10,758.
  Government should endow chairs in, 11,756–11,759.
  In Germany, 11,833, 11,844.
  Suffer from want of science in schools, 12,201.
  Honours for book-work should not be given in, 12,300, 12,306.
  Geography in examinations of, 12,605, 12,610.
  Control over, 12,681.
  In Ireland, 13,414–13,423, 13,480.

UNIVERSITIES—*cont.*
Better application of funds of, 13,571–13,573, 13,585–13,587.
Increasing recognition of science in, 13,612.
Application of endowments in, 13,624–13,627.
See *Cambridge University, Edinburgh University, Oxford University, &c.*

UNIVERSITIES' ACT.
As affecting Scottish universities, 9576, 9729–9735.

UNIVERSITIES' COMMISSION.
Arrangement of chairs, examiners, &c. by, 9626–9629, 9658, 9702.

UNIVERSITIES OF IRELAND.
Correspondence between the Heads of the, and Her Majesty's Commissioners, App. V., Vol. II., pages *16–19*.

UNIVERSITIES OF OXFORD AND CAMBRIDGE.
Correspondence between Her Majesty's Commissioners and the Heads of Colleges and Halls in the, App. VI., Vol. I. pages *9–31*.
Endowments and parliamentary grants, App. VI., Vol. I., pages *9–19*.

UNIVERSITIES OF SCOTLAND.
Correspondence between the Heads of the, and Her Majesty's Commissioners, App. V., Vol. II., pages *5–16*.

UNIVERSITY COLLEGE (LONDON).
Promotion of science at, 513, 687, 718–721, 1172–1282, 1392–1400, 4509, 7124–7201, 7677–7846.
Boarding-hall in connexion with, 513.
Students of, 513, 1172, 4509, 7132–7150, 7164–7199, 7780–7853.
Laboratories, apparatus, &c. at, 1187*a*, 7132–7193, 7779–7853.
Classes in, 1192.
Filling up vacant chairs in, 1193.
Science teachers training at, 1392–1394.
Endowments in, 1400.
Boys from University College School in, 7124, 7149.
Its foundation, title, &c., 7132–7142.
As affected by Government institutions, &c., 7132–7181*a*.
Funds of, 7132–7169, 7799–7859.
Professors of, 7132–7136, 7159–7199, 7677, 7807–7812, 7845, 7854–7857.
Indian Telegraph and Revenue officers at, 7132–7199.
Exemption from religious test in, 7132, 7149.
Charter of Incorporation of, 7133.
Instruction to ladies at, 7133.
Slade School at, 7133, 7142.
Assistant professors at, 7134, 7159, 7164, 7803–7806, 7845.
Chemical instruction at, 7160–7201.
Birkbeck Chemical Laboratory at, 7160, 7164, 7183–7193.
Extension of science to professional purposes at, 7170.
Entrance examination for physics' course desirable at, 7813, 7821.
Education at, should be more accessible, 7846.
Aid given to scientific instruction and the advancement of science by, App. XIII., Vol. I., pages *42, 43*.

UNIVERSITY COLLEGE SCHOOL.
Fees at, 7143.
Boys of, 7144–7158.
Instruction at, 7144.
Teaching of arithmetic at, 7146.
Physics at, 7816–7820.

UNIVERSITY COLLEGE (OXFORD).
Teaching at, 4003.

UNIVERSITY OF ABERDEEN.
Statement with regard to endowments and parliamentary grants, App. V., Vol. II., page 7.
Prof. Bain's communication on the aid given by the University to scientific instruction, pages *7, 8*.

UNIVERSITY OF CAMBRIDGE.
Statement by the Professor of Zoology and Comparative Anatomy in the, App. II. Vol. II., pages *1, 2*.

UNIVERSITY OF DUBLIN.
Statement respecting the scientific school of the, App. V., Vol. II., pages *16–17*.

UNIVERSITY OF DURHAM.
Correspondence between Her Majesty's Commissioners and the Warden of the, App. IV., Vol. II., page *5*.

UNIVERSITY OF EDINBURGH.
Detailed statement as to scientific instruction and the means available for the advancement of science in the, with suggestions for the improvement of the same, App V., Vol. II., pages *8–14*.

UNIVERSITY OF GLASGOW.
Statement with regard to endowments and parliamentary grants, App. V., Vol. II., page *7*.

UNIVERSITY OF LONDON.
Aid given to scientific instruction and the advancement of science by the, App. XIII., Vol. I., pages *41, 42*.

UNIVERSITY OF ST. ANDREW'S.
Statement with regard to endowments and parliamentary grants, App. V., Vol. II., page *5*.
As to connexion with Dundee, page *6*.

UNWIN, REV. W. J., M.A.
Evidence of, 8100–8158. Analysis of Evidence, Vol. I. App. page *119*.

V.

VACATIONS.
At Cambridge University, 4380, 4545–4547.
At Royal School of Mines, 6425–6428.
In universities, are valuable for research, 9515.
In Scottish universities, 9516–9518, 9545, 9606–9608.

VEGETABLE PHYSIOLOGY.
Teaching of, 4898–4914, 4931.
Not suited to children, 4898.

VENTILATION OF MINES.
In the future, 2597–2599.
In Britain, Belgium, &c., 2636–2645.

VETERINARY INSTITUTIONS.
Utilizing, for study of anatomy, 9800.

VICTORIA.
Director of Geological Survey of, 757.
School of Mines in, on Jermyn Street model, 2471.

VIENNA.
Proposed central mining school at, 2325.

VIRGINIA UNIVERSITY.
Supported by the State, 1447.

VISITORS TO MUSEUMS.
To British Museum, 6498–6579, 7471–7744, 9112.
Working men at British Museum, 6501, 6503.
Admission of, on Sundays, 6547–6551, 7471–7509, 9099.
Student visitors, the test of usefulness, 7462.
Cost, per visitor, to national museums, 9067, 9072.
To local museums exhibiting South Kensington objects, 9076.
To Conservatoire des Arts et Métiers, Paris, 9099.
To Museum of Practical Geology, 9107, 13,823.
To National Portrait Gallery, 9145–9147.
To South Kensington Educational Department, 13,833.

VIVIAN, MR.
Employment of assistants from Freiberg, by, 2368.

VOTES (PARLIAMENTARY).
For science for the middle and upper classes in 1867–68, exclusive of the cost of the Queen's Colleges in Ireland, App. II., Vol I., page *5*.

W.

WADHAM COLLEGE (OXFORD).
Promotion of science at, 2997, 3233.

WAGES.
Suggested tax on miners' wages for scientific education, 2586–2591, 2619–2623, 2648–2650.

WALES.
Progress of Geological Survey in, 754, 756.
Managers of mines, &c. in, 2335, 2367–2369.
School of Mines supplies mining managers to, 2369.
As a locality for a mining school, 2510, 2567–2570, 2576.
Loss of life in mines in, 2546.
Proposed mining school at Merthyr, 2567–2570, 6415.
Wages and scientific instruction in, 2587–2590.
Fiery mines in, 2638.
Pupils in Bristol Trade School from, 6408.

WALL, MR.
Directed Geological Surveys of Trinidad and Jamaica, 757.

War Department.
Scientific knowledge in, 11,926–11,928.

Washington.
Agricultural Department at, 1422, 1535.

Watchmaking.
Scientific knowledge of Swiss in, 2010.

Waterhouse, G. R., Esq.
Evidence of, 7761–7778. Analysis of Evidence, Vol. II. App. page *140*.
On New Natural History Museum at South Kensington, 6604.
On convenience of British Museum over Kew, 7744.

Water Supply.
Advice by Geological Survey respecting, 706.
Control of, by Board of Trade, 12,623–12,631, 12,637.

Water Supply Commission.
Analyses for, 5772.

Watkins, Rev. Frederick.
Evidence of, 8608–8724. Analysis of Evidence, Vol. I. App. page *125*.

Watt Institution, Edinburgh.
For artizans, 1630–1644.

Waynflete Professorships (Oxford).
For chemistry, &c., 3381–3384.

Weights and Measures.
Need of accurate national standards of, 10,678–10,680, 11,656, 11,891.
Teaching of, in schools, 11,656, 11,708–11,714.
Charts and models for teaching, 11,656.
Metric system of, in Germany and France, 11,656.
Want of uniform system of, in India, 11,891.
See *Standards*.

Wellington College.
Pupils from, at Woolwich examinations, 4106.

Wesleyan Training College, Westminster.
Science teaching in, 8032–8079.
Scientific instruction for female students in, desirable, 8035–8040, 8062.
Students of, 8035–8064.
Third year's course desirable in, 8043–8048.
Five schools connected with, 8078.

Westminster School.
Studentships at Christ Church College, Oxford, for boys from, 4170.

Whately, Archbishop.
On limiting tenure of fellowships, 5535.

Whewell, Dr.
Teaching of mineralogy by, 4113.

Whitworth Scholarships.
Educational preparation for, 206, 247.
Candidates for, 768, 7409.
Artizans who have gained them, 7409.
Theoretical with practical study essential for, 6979.

Whitworth, Sir Joseph.
Difficulty of, as to education of his articled pupils, 8830.

Wigan.
Examination papers from, 2375.

Williamson, Dr. A. W., F.R.S.
Evidence of, 1169–1402; 7159–7202; 12,680–12,704. Analysis of Evidence, Vol. I. App. page *86*; and Vol. II. App. pages *151*, *206*.

Willis, Rev. R., M.A.
Evidence of, 4654–4699. Analysis of Evidence, Vol. II. App. page *116*.

Wilmot. See *Eardley-Wilmot, Major*.

Wilson, Mr.
Teaching of science at Rugby by, 3697.

Winter.
For botanical instruction, 4921–4931.

Wood, Mr. Nicholas.
On education of colliery viewers, 2506.
On a school of science at Durham, 8757, 8795–8798.

Woolley, Rev. J., LL.D.
Evidence of, 836–1020. Analysis of Evidence, Vol. I. App. page *83*.
Portsmouth Dockyard School under, 1027.
Connection of, with School of Naval Architecture, 1028, 1038.

Woolwich.
Academy at, and School of Naval Architecture, 940.
Candidates for, 4604–4609.
No systematic research in Arsenal of, 11,927, 11,957.
Undesirable locality for a great national laboratory, 11,948.
Government establishments at, should not be controlled by a scientific council, 12,256.
Studies at, 1339, 1353–1359.

Worcester.
Attempt at, to follow example of Bristol Trade School, 5945.

Working Men. See *Artizans*.

Working Men's College, Manchester.
Absorbed into Owens College, 7251.

Workshops.
Technical instruction in, 1678–1686, 1759–1783, 2793–2859, 3373, 3425, 9186–9608.
Approximation to, at École des Arts et Métiers, Paris, 1759.
At King's College, 4680.
Objection to, for colleges, 9186–9191, 9511, 9532*a*–9535.
Objection to, for Glasgow University, 9511, 9532*a*–9535, 9608.
Advantage to professors of having access to, 9550.

Wurtz, M.
On German laboratories, 7385.

Wylie, Mr.
Conducted Geological Survey of the Cape, 757.

Y.

Yale College (New Haven).
Education, &c. at, 1519, 1558.

York and Ripon Diocesan Training College.
Science at, 8207–8210.

York Museum.
Natural history collections in, 3103.

Yorkshire.
Scientific education in, 6122.
Increased study of natural history in, 6144.
Feeling in, regarding aid to science, 6145, 6166.
Aid of employers to mechanics' institutions in, 6145–6147, 8898.
Teachers in, 6203–6205.
Memorandum, by Henry H. Sales, on the progress of scientific instruction in, App. XI., Vol. I., pages *39–41*.

Yorkshire Board of Education and Union of Mechanics' Institutes.
Object, inspection, &c. under, 6113–6120, 6189, 6199.
Report to, on scientific education, 6122.

Yorkshire College of Science (proposed .
Instruction, fees, &c. in, 6144, 6148, 6166–6169, 8266.

Young, James, Esq.
Evidence of, 10,020–10,058. Analysis of Evidence, Vol. II. App. page *177*.

Young, John, Esq., M.D.
Evidence of, 9569–9614. Analysis of Evidence, Vol. II. App. page *172*.

Z.

Zoological Gardens (Dublin).
Supply of specimens by, &c., 12,944–12,953.

Zoological Society (Dublin).
Government of, &c., 9055, 9063–9066.

Zoological Society (London).
Aid by, to British Museum, 6832, 6840.

Zoology.
Payments by State for, 115.
Examinations in, 254–265.
Difficulty in teaching, 356.
Independent professorship for, 2741–2743, 5354, 9464–9799.

ZOOLOGY—*cont.*
- Separation of geology from, 2743, 5354, 9464–9799.
- At Oxford University, 3280–3283, 3781, 3817, 4108, 4132–4143, 5354.
- Scholarships wanted for, 3781, 4108.
- Not adapted for a school of examination, 4119–4121.
- At Cambridge University, 4265, 5108.
- Teaching of, in schools, 4616, 5226.
- In Indian Civil Service examinations, 5237, 7873–7877.
- In proposed college of science, 5953–6000.
- At British Museum, 6522, 6767.
- As affected by palæontology, 6814–6823.
- Anatomy and zoology, 6852.
- At College of Surgeons, 6853.
- At new natural history museum, South Kensington, 6853.
- At Edinburgh University, 9264, 9324, 9379, 9464, 9496.
- At Glasgow University, 9571–9578, 9610, 9797–9799.

ZOOLOGY—*cont.*
- Zoological Society's Museum, 12,119–12,121.
- At Dublin University, 12,890–12,956.
- At Royal Dublin Society, 12,941–12,943.
- At Queen's College, Galway, 13,156.
- At Queen's College, Cork, 13,201.

ZOOPHYTOLOGY.
- Lectures on, might be given at British Museum, 6593, 6613, 6641.

ZURICH.
- Laboratory at, 47.
- Scientific instruction in, 7384, 7389.
- Primary schools in, 8149–8155.

ZWICKAU.
- Free Mining School at, 7389.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's Most Excellent Majesty.
For Her Majesty's Stationery Office.